Electronic Helpdesk Support System in Tertiary Institutions in Developing Countries

(A Case Study of Lagos State University, Nigeria)

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Abstract--- **e-Helpdesk is a digital system used to systematically and efficiently manage users' complaints in an organization. It provides customers with help in various forms and thus enables companies to maintain a high quality customer service. Conventionally, helpdesk services require sets of human experts with different expertise and abilities to solve customers' problems in any given domain. The dearth of highly skilled experts in various domains of work calls for electronic Helpdesk (e-Helpdesk) in organizations. Today, in many of the tertiary institutions in the developing countries (e.g. Nigeria), users (i.e. students, teaching staff and non-teaching staff) go through manual process of logging their complaints or requests to helpdesk officers in relevant units. Each user in need of help is required to submit, as hardcopy, a letter of complaints or complete complaint or requisition form stating his/her problems or needs. The letter or form is then processed manually by the helpdesk officer. This manual approach to helpdesk management is time consuming, monotonous and lacks efficiency. It also makes record tracking or processing of large volume of complaints very difficult and it is very susceptible to loss of record. In addressing these challenges, e-Helpdesk system is proposed in this paper. The system architecture is designed using Model-View-Controller design pattern and the prototype was implemented using Coldfusion and MySQL relational database management system. The prototype was tested with data collected from Lagos State University, Lagos, Nigeria. The results produced vis-à-vis the system performance were observed and they are found to be better than the existing manual helpdesk system in terms of speed, accuracy, data shareability, multiple processing of users requests, processing large volume of data and ease of use by users.**

I.   INTRODUCTION

Helpdesk is a customer support centre in an organization that provides information, administrative and technical supports to users, with the view to solving problems that users encounter in the course of using the organization resources or facilities. A helpdesk could comprise of one person or group of persons that make use of telephone devices or software applications to keep track of problem(s) status and thus provide solution(s) that satisfy the users [1-4]. Helpdesk could also be seen as an information and assistance resource that supports the functionality of an organization by responding to users' requests in a timely manner [4]. It is hence, a core sector through which problems, complaints and requests are reported, managed, coordinated and resolved [5]. Helpdesk software is a solution application that is used for managing organization's helpdesk [1]. It is accessible to customer support personnel who could direct request(s) to servicing department(s).

In a business enterprise, helpdesk unit is a place that users call to get help for a problem. Helpdesk can be classified into Internal helpdesk (this is used to serve the employee within the organization) or External helpdesk (this is used to serve people that are external to the organization) [6]. Irrespective of the category, the smooth operation of the helpdesk is fundamental to the smooth running of the organization [6, 7]. Helpdesk management methods vary

from one type of organization to the other. In many small scale companies, a helpdesk is simply one person that has some ideas of how to handle the users' problems and users can contact him/her only by phone. In larger companies, a helpdesk may consist of a group of experts using dedicated software to: keep track of the status of user's problems, analyse the problems and thus provide solutions to the problems. Moreover in some multi-national corporate organizations, helpdesk support can be provided to customers via a toll-free telephone number, website or e-mail.

In Nigerian tertiary institutions and many of the tertiary institutions in developing countries of Africa, helpdesk processes are handled manually and thus poses a lot of difficulties to both the helpdesk officers and the users. There are three conventional manual methods currently used for reporting problems in Nigerian institutions: (1) making requisition/complaints via the phone (2) making requisition/complaints via e-mail and (3) the use of Requisition/Complaint form. Presented in Figure 1 is the diagrammatic illustration of the current manual method for reporting problems to the different servicing departments. There is a lot of repetitive work on problems that have simple solutions. Also, problems that appear on a regular basis still go through the same process and therefore cause delay. Staff and students are confronted daily with recurring problems for which the cause never gets addressed or eliminated. They have to explain their problems or complaints to support staff and wait a long time for problem resolution. There is also lack of follow-up of requests that need attention.

Additionally, getting access to the support team could be quite challenging, even though there is telephone but there is no tool to log the problems automatically for the support personnel to attend to the problems later. Users have to keep on trying to contact the support personnel for days or weeks before getting access. Upon receiving the complaints, the support personnel will have to pass the case to the appropriate administrator. These could take additional hours or sometimes days to complete. This could reduce productivity or hinder management functions. Also, the current manual method does not have any system which could allow the user to monitor progress on the reported complaints.

In view of these limitations, there is the need for computer aided helpdesk system solution tagged e-Helpdesk for tertiary institutions in developing countries as currently done in developed world. It is a user friendly distributed software system that can serve as virtual partner to the human helpdesk officers. The conceptual design of e-Helpdesk for tertiary institutions in developing countries is presented in this paper. The proposed e-Helpdesk would be able to overcome the challenges of delay, loss of records, improper documentation and many others; by routing specific requests

to the appropriate administrator electronically via established Intranet and Internet system and thus bringing about proper documentation and accountability.

The main users of the system are typically divided into four categories as follows:

a. User/Requestor: Requestors include staff and students of the institution and other individuals seeking information about the institution. The requestor makes all the requests through the e-Helpdesk for resolution. The request will contain the actual complaints and some information about the requestor, as well as his/her department. The requestor will also be able to access possible solutions to or information about his/her complaints/problems from the knowledgebase. Information retrieved from the knowledgebase depends on the privilege given to the requestor.

b. Helpdesk Department: This department receives all requests from the public, students and staff, and sends them to the appropriate servicing department(s). Helpdesk department liaises with stakeholders (i.e. experts) in the servicing department(s) in order to ensure that necessary solutions are provided to requestor's satisfaction and documented. The department also ensures that e-Helpdesk is on and working and reports problems with the system to the technical team for quick resolution.

c. The Information and Communications Technology (ICT) Department: This department provides technology and maintenance support (i.e. hardware and software) for e-Helpdesk. ICT attends to technical issues with the system as indicated by the helpdesk department.

d. Servicing Departments: These are the departments that are solely responsible for providing solutions to requestors' complaints/requests. They hold the information required to solve these issues. They are able to see all requests and respond to them accordingly. When items or services are required by staff or students, they provide such items or services and allow the requestor to submit feedbacks.

This paper is structured as follows: related research works on helpdesk process is presented in Section II; the conceptual design of e-Helpdesk is presented in Section III; system implementation is presented in Section IV and conclusion is presented in Section V.

II. RELATED WORKS

Helpdesk management system has attracted a number of research works. For example, in developed world, helpdesk has been established as a tool for inquiries made by users (i.e. students and staff) on institution facilities and services

[8-12], hence keeping both students and staff members abreast of institutional functions. Also, helpdesk has been

proposed as a tool for creating a good culture of service in the IT Organization [13-15].
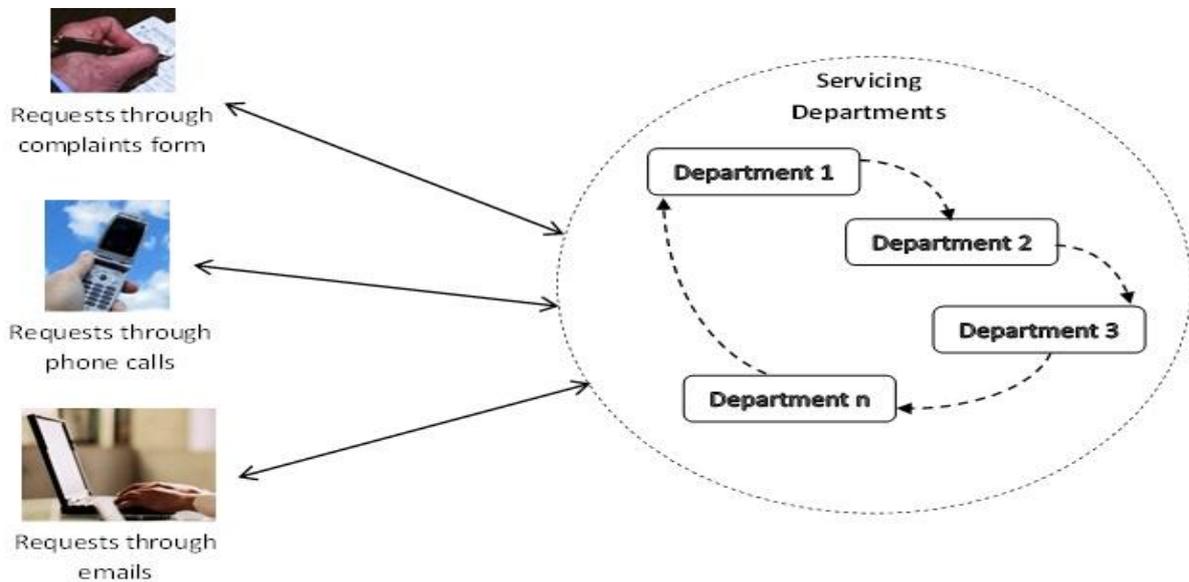

Figure 1   Current Manual Helpdesk Process

Additionally, helpdesk information retrieval mechanism has been developed [16-18] and was demonstrated to be suitable for users and thus used in managing their complaints and proper system maintenance. The system has a knowledgebase and thus helps to improve helpdesk usability. Also, facility management helpdesk has been recommended as a good tool that could enhance systematic management of users' complaints in tertiary institutions [19-21].

Contrary to the excellent customer satisfactions recorded in the developed world [22] the current helpdesk method in Nigerian tertiary institutions lacks consistent feedback processes and uses transactional rather than holistic view of services and manifests fuzzy understanding of the metric of service [13]. These could explain the gap and dissonances in the shared understanding of IT helpdesk services in tertiary institutions. Most tertiary institutions in Nigeria provide helpdesk services via telephone, email and in-person either at the helpdesk location or at the user's location [9].

III.   CONCEPTUAL FRAMEWORK OF e-HELPDESK

Helpdesk system entails the following: receiving requests, queries and complaints; generating reports on identified problems; classification of mails received; filing mails; responding to problems/queries/complaints stated in mails;

keeping track of problem status; ensuring all cases are attended to and closed when users ascertain their satisfaction [19, 23-25]. e-Helpdesk is modelled using Unified Modelling Language (UML). In this section we present the system architecture, system workflow diagram, data model, and envisaged transactions**.**

A.   System Architecture for e-Helpdesk

The system architecture is presented in Figure 2. Model-View-Controller (MVC) software architecture pattern is adopted in designing the architecture of proposed e-Helpdesk. The MVC pattern divides the architecture into three interconnected units such that the user interface logic is separated from business logic. The Model represents the update and business logic functions of the system and thus changes the state of the system. It produces notices of change of state and the new state of the system. The View represents the components of the user interface. It allows the users to enter commands that change the state of the system. The Controller carries out the following functions: (1) Sends notice to the console using a constructor; (2) Initializes the model using a defined method; and (3) Gets references to the Model and View using defined methods.

The architecture is divided into the following layers based on the MVC paradigm adopted: User Interface Layer, Knowledgebase Layer and Business Logic Layer. The User Interface Layer represents the views of the users. It consists

of functional components that present whatever users' view captured in the knowledgebase to the users when requested. It is composed of various graphical interfaces/windows having all components/icons through which the users interact with the back-end of the system and also through which the users interact with one another. The Knowledgebase Layer is composed of the system database that serves as the repository for data/information and rules on helpdesk operations in the institutions. It also contains the methods that controls access to the knowledgebase and thus synchronizes requests in order to ensure data integrity. The Business Logic Layer consists of components that perform the following functions:

a. **Authorization Component:** This component authorizes a user. i.e. determine if a user is allowed to gain access into the system components. This component is used by other components to ensure a user is allowed to perform the corresponding function.

b. **Request Creator Component:** This component negotiates with a requestor to create a new request which is eventually added to the knowledgebase. The request may be information, item or services.

c. **Request Servicing Component:** The requestor, helpdesk and servicing departments interact with this component in order to service a request. It provides the back-end interface through which users' requests/complaints are being serviced by the servicing department.

d. **Report Component:** The system's report modules are executed here.

e. **Knowledgebase Update Component:** This component helps the helpdesk department and other authorized users to update the knowledgebase with required data/information.

f. **Knowledgebase Browser:** The knowledgebase browser allows the requestor to search the knowledgebase for possible solutions or answers to a problem/request/complaint.

B. System workflow for e-Helpdesk

e-Helpdesk is proposed to be a web client-server based distributed software system in which multiple autonomous client systems connects to distributed servers via established Intranet or Internet connection. Client-server architecture is adopted because e-Helpdesk is expected to be used by a large number of users from different locations. All communication is over the network with the server on the institutions intra-network. The workflow diagram is presented in Figure 3.

Requestors or End users are the initiators of every request made to the helpdesk. Requests are made to the helpdesk via browsers residing on client workstation. The Requestors must be registered users of the system. Once a Requestor makes a request, the request is immediately forwarded to representative of the servicing department if specified or to the help desk department which forward the request to the

servicing department(s). The representative may be a clerk, Faculty/College Dean, Head of Department e.t.c and may even be an Approving Officer. The request is forwarded to the necessary units for servicing but first to the Approving officer if not information based. Once approved, the intended service provider(s) in the servicing department services the request and indicates completion. The requestor will then indicate satisfaction once done. Also the transaction history and relevant data/information about the transaction are stored in the knowledgebase for future use by management of the institution or the helpdesk department.

C. Data Model of e-Helpdesk

Relational data model is adopted to represent the data objects considered for e-Helpdesk. According to [26-29], a relation R on n sets $D_1, D_2, D_3, ..., D_n$ is a set of n-tuples:

$$(A_1:d_1, A_2:d_2, A_3:d_3, ..., A_n:d_n) \text{ such that } d_1 \in D_1, d_2 \in D_2, d_3 \in D_3, ..., d_n \in D_n$$

Where: $A_1, A_2, A_3, ..., A_n$ are attributes with domains $D_1, D_2, D_3,..., D_n$ and the tuples having the form $(d_1, d_2, d_3, ..., d_n)$ and each value is taken from the appropriate domain.

Moreover, if $P_1, P_2, P_3, ..., P_n$ are set of relation schemas, then the general form of Relational Database Schema [26], P is:

$$P = \{P_1, P_2, P_3, ..., P_n\}$$

Where: $P_1, P_2, P_3, ..., P_n$ are different relation schemas with specific attributes over given domains.

The database of e-Helpdesk is a network of objects that are semantically related and thus the Relational Database Schema, *HELP_DESK* is:

$$HELP\_DESK = \{USER\_CATEGORIES,$$
$$USER\_ROLES, USERS,$$
$$REQUEST\_CATEGORIES,$$
$$REQUESTS,$$
$$REQUEST\_ITEMS,$$
$$REQUEST\_MESSAGES\}$$

The relations schemas are:

a. USER_CATEGORIES[<u>id</u>:*integer,* name:*string*]

b. USER_ROLES[<u>id</u>:*integer,*user_category_id:*integer,* name:*string*]

c. USERS[<u>id</u>:*integer*, firstname:*string*, lastname:*string*, username:*string*, password:*string*, status: *integer,* active:*integer*, user_role_id:*integer*]

d. REQUEST_CATEGORIES[<u>id</u>:*integer*, name:*string*]

e. REQUESTS[<u>id</u>:*integer*, description:*string*, user_id:*integer*, request_category_id:*integer*, targeted_user_category:*integer*, current_status:*string*]

f. REQUEST_ITEMS[<u>id</u>:*integer,*name:*string*, request_id:*integer*]

g. REQUEST_MESSAGES[id:*integer*, from:*string*, to:*string*, message:*string*, cc:*string*, bcc:*string*, request_id:*string*]

The logical relationship of the data objects is presented in Figure 4.
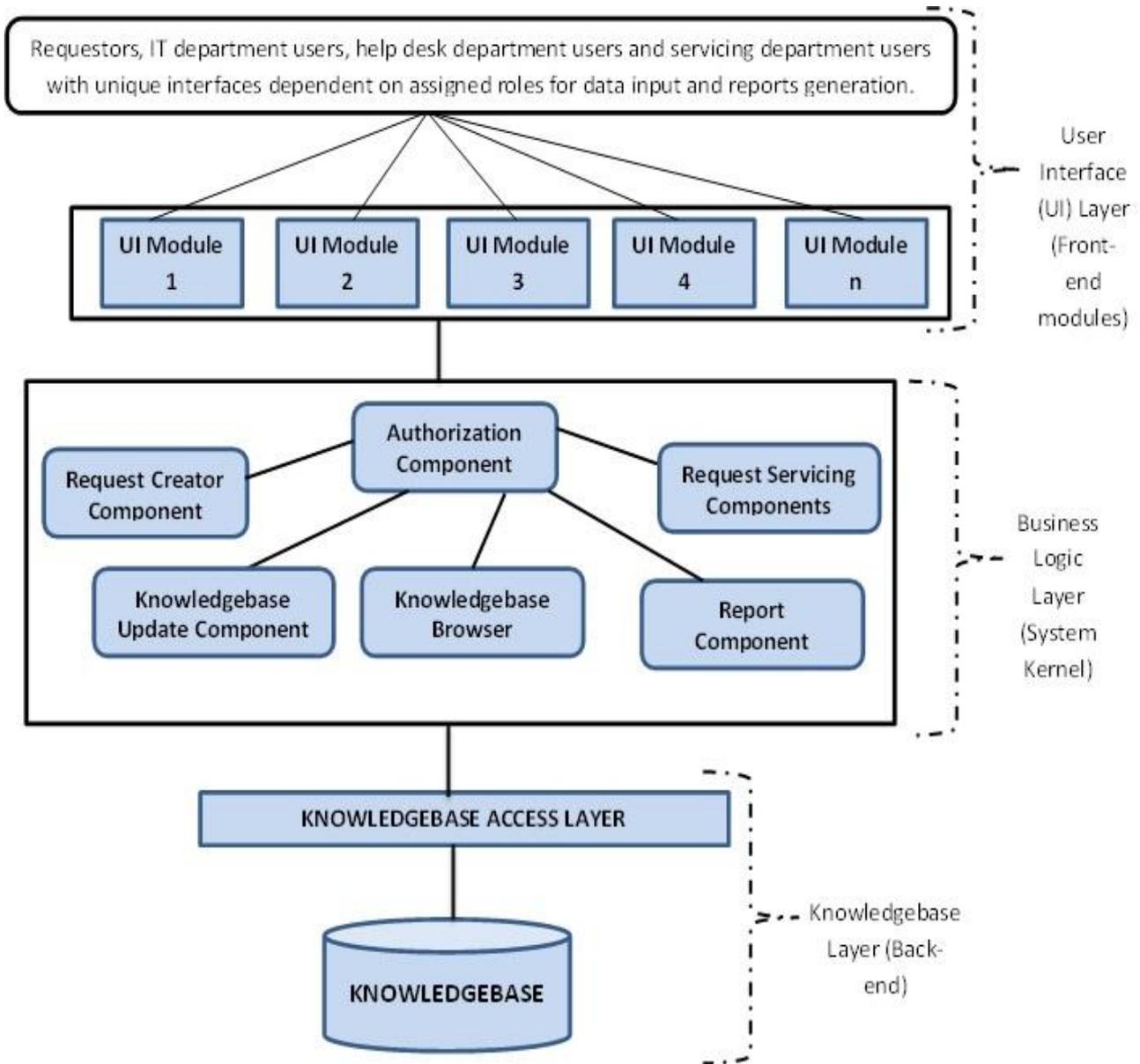

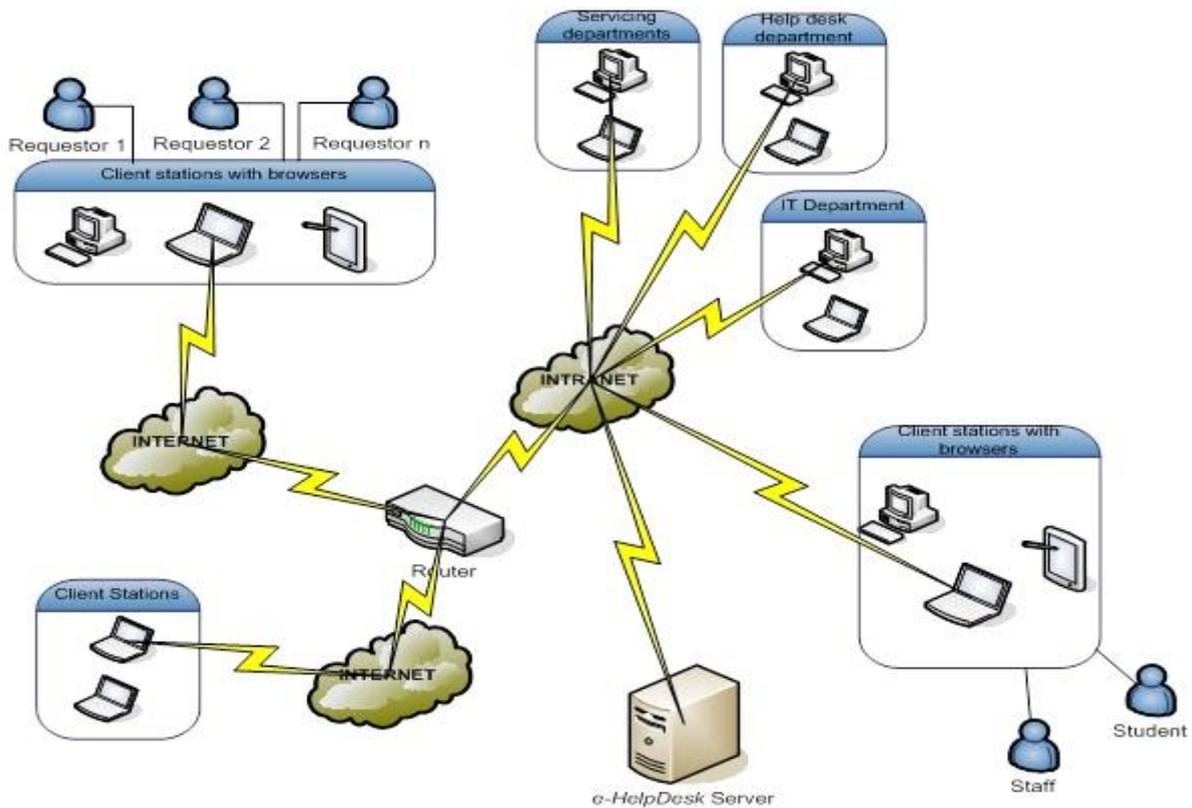**Figure 2.   System Architecture for e-HelpDesk**

Figure 3   Workflow Diagram for e-HelpDesk

TABLE 1   DESCRIPTION OF E-HELPDESK RELATIONS

|	Relation Name	Description
1.	USERS	This relation stores the information about all the users of the system. Authorization to any part of the system is based on their roles and the actual category they belong to.
2.	USER_ROLES	This relation stores meta information and indicates authorization level about users. Roles are dependent on the category the user belongs. For example, approving officer and executing officer may exists in the Servicing departments while administrator may be found in the IT department.
3.	USER_CATEGORIES	User category stores information about which department a user belongs to. The data here will be fixed as long as the system is not altered to cater for newer or removal of departments.
4.	REQUESTS	All requests made using the system are stored on the requests table. Each request is associated with an ID and this is used for tracking the request status and any communication regarding the request.
5.	REQUEST_ITEMS	Requests may be item based i.e an item is requested. This relation will store all information about requested items and the delivery status indicating whether the request has been totally, partially or not serviced.
6.	REQUEST_MESSAGES	This relation stores all messages exchanged between parties involved with a request. The request_id is used to identify the request.
7.	REQUEST_CATEGORIES	Each request belongs to a category in a defined and finite set. Meaning there is a fixed list of categories a request can belong to. Categories include information based, item request, service request e.t.c.
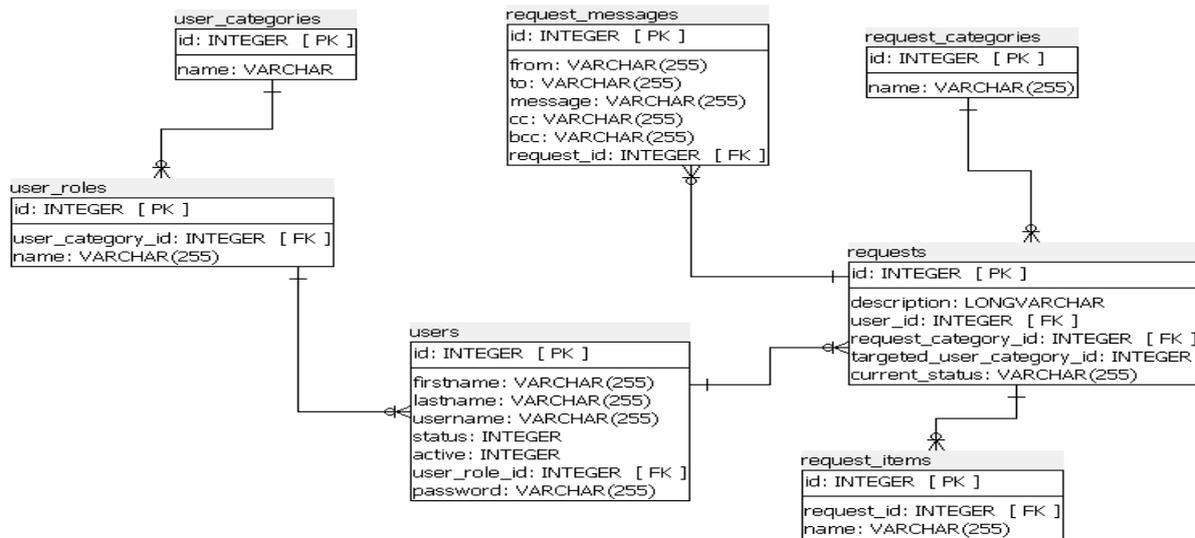
Figure 4   **Logical Relationships of the Data Objects of e-Helpdesk**

D.   *Transactions on e-Helpdesk*

Transactions can be described as the activities that users' carry out on the database. A transaction may be an update transaction or query type transaction [26]. Update transactions are the activities that are responsible for the insertion of new records, modification of existing records and deletion of unwanted records in the database. Query transactions are the activities that are responsible for retrieving and processing records from the database with the view of generating specific reports for management decision making.

The transactions envisaged for the system are grouped into the following: Create, Read, Update and Delete. The acronym given is *CRUD.*

  a.   Create Transactions
  - i.   Add users
  - ii.   Add request
  - iii.   Add/Send message referring to a request
  b.   Report Transactions
  - i.   View/print users record
  - ii.   View/print request(s)
  - iii.   View/print thread of messages associated with a request
  - iv.   View/print list of cases (request/problem) reported in a given period
  - v.   View/print List of solved and unsolved requests
  - vi.   Display/print status of requests
  c.   Update Transactions
  - i.   Update user data
  - ii.   Update request status
  d.   Delete Transaction
  - i.   Remove invalid requests.
  - ii.   Delete repeated users

IV.   SYSTEM IMPLEMENTATION

This section discusses the implementation of e-Helpdesk vis-à-vis the functions, features and composition of both the front-end and the back-end. The implementation tools used are: Coldfusion [30], MySQL [31] and NAVICAT [32] database management applications. They are open source applications that have tremendous success in client server applications. The system runs on the platform of Windows operating system. The minimum hardware requirement needed to implement the system is: Pentium 4 with 2.5MHz processor, 1GB RAM and 120GB HDD. To run the proposed system, the user is required to visit the website of the institution and login using the login details provided by the IT department for all staff of the institution. There are two categories of users: Technical Users and Normal End-Users (Requestors). The technical user is responsible for managing all users and requestors. He/She is also responsible for managing all departments. It is also the responsibility of the technical users to attend to all technical operation that has to do with the system. A user in each category login to the system using his/her unique authorization details (User name and password). Before login and immediately after supplying the URL of the e-helpdesk to any web browser, the welcome screen is displayed (Figure 5). The user is then required to click the login button which launches the login page as showed in Figure 6. The list of registered users is presented in Figure 7. Once a user successfully login, he/she makes his/her requests via the users' request page (Figure 8). Each request is passed to the required servicing department and once the request is serviced, the system displays the solution provided vis-à-vis the status of the request as presented in Figure 9. Once a request is successfully serviced, the system notifies the requestor and changes the request status

to "Resolved" (Figure 10) and closes the transaction when users ascertain their satisfaction.
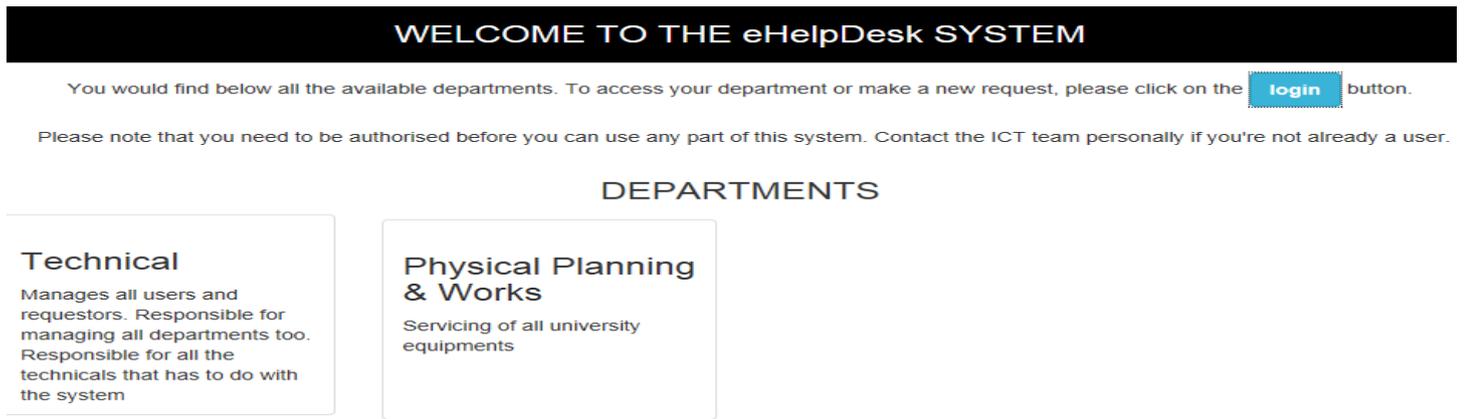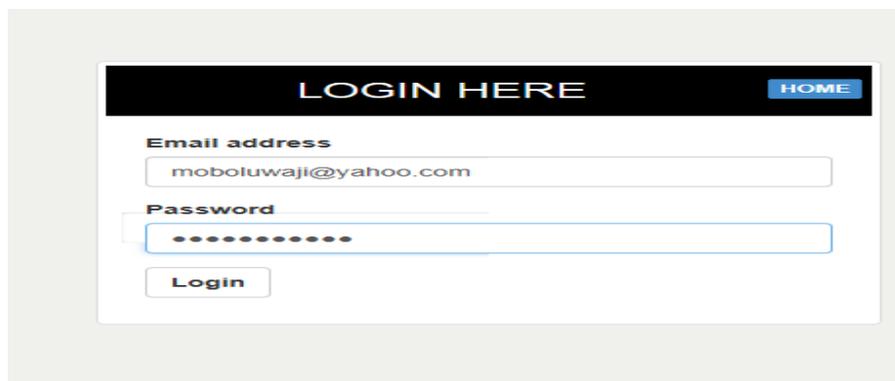

Figure 5   Screenshot of Welcome Interface

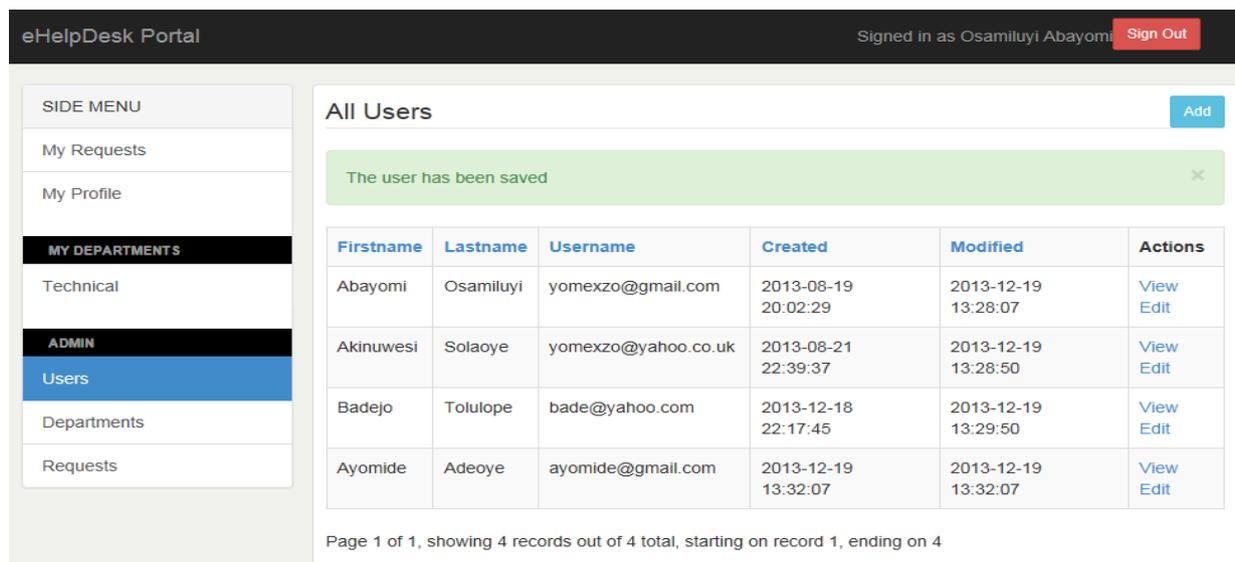**Figure 6   Screenshot of User Login Interface**

Figure 7   List of Registered Users

Figure 8   Interface for Users to make Request and Submit

Figure 9   List of Submitted Users' Requests with their Status
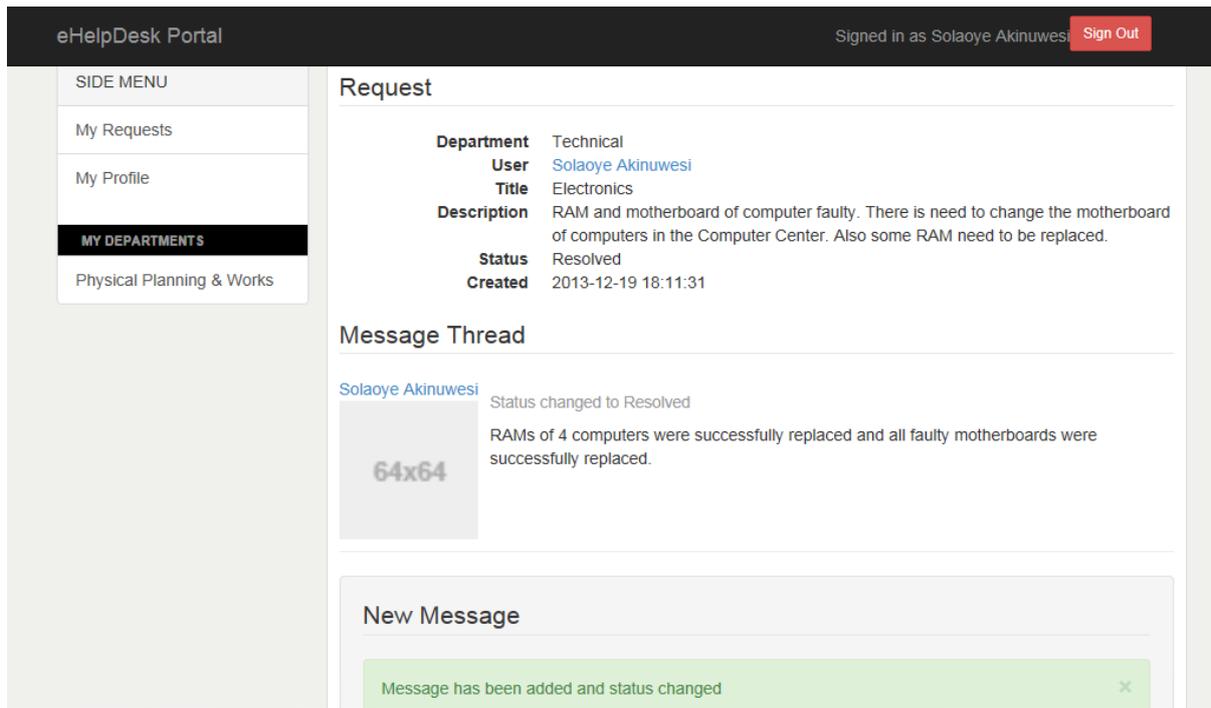
Figure 10   Sample of Solved Request

V.   CONCLUSION

In this paper, we proposed a design for e-Helpdesk and a conceptual framework for electronic helpdesk system, which can be adopted by any tertiary institution. The proposed system automates the process of request submission to the helpdesk department. It also provides a platform for users to receive help on various requests ranging from system failures to service provision. Therefore, it will be a central point through which problems could be reported and managed. e-Helpdesk, if implemented, will serve as a computer based platform that will effectively and efficiently carry out users' support services in tertiary institution. e-Helpdesk provides the tools to carry out the following functions:

a. Enables users to obtain information regarding the institution support services.
b. Reduce turnaround time to complete requests submitted by users.
c. Storage of records about helpdesk history, resolution tools, workflow for all helpdesk activities and automated escalation tools for timely support.
d. Find, analyse, and eliminate common problems in the institution.
e. Handle problems efficiently; maintain audit trails and enable helpdesk staff free up for more useful tasks.
f. Enables management to measure problems resolved by the service provision departments to give them a fair rating during KPI (Key Performance Indicator) review.

Listed below are the benefits of e-Helpdesk:

a. To log, analyse and assist in the resolution of helpdesk issues
b. There is database of users' details, helpdesk history and resolution tools.
c. There is action log to record every event in a helpdesk job history.
d. There is structured workflow for all helpdesk activity.
e. There is automated escalation tools to assist in timely support solution
f. Helpdesk managers can quickly generate meaningful reports that can highlight performance bottlenecks, recurring client issues, and outstanding service.
g. Some institutions provide services to companies and other institutions, therefore with e-Helpdesk, helpdesk managers are able to quickly configure complex escalation and service level agreement rules so that their helpdesk support is effective and provides the level of service that clients demand.

Based on the aforementioned benefits, the following constraints are enforced: (1) Users are enforced to use a specific workflow as defined by the management of the institution and (2) service level agreement rules must be implemented in order to automate request/problem escalation procedure stated therein.

Considering the economy of developing countries, e-Helpdesk is affordable because the implementation is based on Open Source applications.

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BIOGRAPHICAL NOTES

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book, book chapter, journals and refereed conference proceedings). He is a Full Member of the following professional bodies: Computer Professionals Registration Council of Nigeria (MCPN), Association for Computing Machinery (MACM), Nigeria Computer Society (MNCS). He was awarded *C.ITP* (Chartered Information Technology Practitioner) in 2009 by the Computer Professionals Registration Council of Nigeria. He has over 14 year of teaching and administrative experiences in the University. He had served as Acting Head of Department and also Acting Director of University Computer Center. He had also served in several University Management Committees. As Acting Director of University Computer Center, he initiated and implemented several ICT projects for the University. He is on the review board of a number of Computer Science journals/conferences. His research areas are: User-Centricity, Software Performance Engineering, Software Engineering, Database System, Expert System, Neural Networking, Fuzzy Logic, Artificial Intelligence, Computer programming concept, Technology Adoption.

Professor Faith-Michael E. Uzoka: Professor Faith-Michael E. Uzoka is a Professor of Information Systems in the Department of Computer Science and Information Systems, Mount Royal University, Canada. He obtained his MBA in 1995, his MSc in 1998 and his PhD in 2003, all in Computer Science with focus on Information Systems. He also conducted a two-year postdoctoral research at the University of Calgary (2004–2005). He is on the editorial/review board of a number of information systems and medical informatics journals/conferences. His research interests are in medical decision support systems, evaluation systems using soft-computing technology, organizational computing and personnel issues, and technology adoption/innovation.

Professor Benjamin Aribisala: Professor Benjamin Aribisala is a Professor of Computer Science in the department of Computer Science, Lagos State University. He obtained his PhD degree in Computer Science from the University of Birmingham, United Kingdom. He has BSc degree in Mathematics, from University of Ado Ekiti and MTech. Computer Science from Federal University of Technology, Akure. Professor. Aribisala has worked in the University of Edinburgh, Newcastle University and University of Birmingham, all in the United Kingdom. Professor Aribisala combines his expertise in Computer Science, Mathematics and Image Analysis to conduct state-of-art clinical research. His current research interests span the fields of image analysis, artificial intelligence and computer vision. He has published several academic articles and given presentations to both local and international audience all over the world, ranging from Nigeria to USA, China, Canada, Austria, Germany, Portugal and United Kingdom. He is a reviewer for many international journals.

Dr. Toyin Enikuomehin: Dr. Toyin Enikuomehin is a Lecturer 1 at the Department of Computer Science, Lagos State University and the Head, Application Development and Data Services Centre of the University's External System. He has his PhD in Computer Science. His current research is concerned at developing applications for modelling emotions in information retrieval and the development of search space reduction softwares. He is also involved in the development of biologically inspired search engines. He has made significant and balanced contributions to the University in scientific leadership through research, leading to the development of many in-house softwares used within and outside the university. He has demonstrated strong leadership skills in coordinating and undertaking major research projects in ICT setting being the immediate past coordinator of the State's ICT centre where all IT related services were deployed and maintained. He currently serves as programming consultant to some highly rated GSM service providers in Nigeria. His academic research experience has led to several academic publications across America, Europe, Asia and Africa in his field of research. Presently, he's working on pattern prediction softwares for the electroencephalogram and *magneto encephalogram* data. He believes that understanding this data pattern can help to improve the satisfaction level of search engine users. His major research domain include Natural Language Processing, Cognitive-based Information Retrieval and Web Services. He is a member of several reputable associations like the British Computer Society, America Association of Artificial Intelligence, Nigeria Computer Professional Association, Nigeria Association of Mathematical Physicist amongst others.

Onyekachi C. Onwudike: Onyekachi Onwudike obtained her Bachelor of Technology degree in Computer Science from the Bells University of Technology Ota in 2010. On completing her degree in Computer Science, she proceeded to the University of Manchester, United Kingdom in 2011 to pursue her Master's degree. Following the completion of her Masters Degree in Advanced Computer Science with a specialization in Artificial Intelligence in 2012, she proceeded to Loughborough University, United Kingdom in 2013 where she is presently carrying out her PhD research still in the field of Artificial Intelligence. Her research interests include Database Systems, Help Desk systems, Software Engineering, System Analysis and Design. However her current research interests include E-Government systems, ontologies of E-Government, Software Requirements traceability and reuse in E-Government systems with the use of ontologies

Abayomi Osamiluyi: Mr Abayomi Osamiluyi obtained his Bachelor of Technology degree in Computer Science in Bells University, Ota, Ogun State, Nigeria. He is a programmer and currently works with Delivery Science, a data science software company interested in solving proof of delivery and supply chain problems. His research areas are in Software Engineering, System Analysis and design and Expert Systems.