A Proposal to Build a Knowledge Management System based on the Service Approach in the Context of Academic Library Digitalization at Jazan University-Saudi Arabia

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Abstract

In the previous decade, most of the major universities and public library systems have switched over to computers. However, almost all these library systems follow traditional implementation approaches which make it very difficult for them to interact with other systems or migrate to emerging technologies. Also, while most of the library systems do provide online, remote and public access catalogues for knowledge but they have still not utilized the power of cutting edge technologies to take complete advantage of the resources of virtual world. The subject of digital library includes online catalogues, real-time databases etc, while being used extensively in many fields, are still relatively unexplored in the academic world. In order to create a system which provides integrative, normative, reliability and inclusiveness with latest features yet remains open for modifications and extensions. It is important to choose an implementation approach which supports interoperability, abstraction and loose coupling of components and resources. Towards this end, Service oriented architectural approach (SOA) has proved to be very successful in fulfilling these needs in several areas. The idea behind this study is to propose a complete digital library and information services based learning environment using the SOA approach to apply for the academic libraries resources of the Jazan University so that gaps in terms of knowledge management as well as other services needs can be fulfilled with a single centralized architecture and framework.

Keywords: Knowledge management, SOA; digitization; virtual rooms; online databases; interoperability; abstraction

Introduction

Due to the traditional implementation approaches followed by most Knowledge management systems in digital libraries, including new features and merging the system with other systems is quite difficult. In several Universities, interlibrary loan, payment of fees….. etc are a tedious and often manual process. At the same time, it has become increasingly important for academic libraries to be able to interact with each other in order to increase the boundaries of knowledge and resources as evident by the need for interlibrary loans, tie-ups between different libraries….. etc despite the difficulties in implementing them. Also, more and more students are expressing the need for virtual learning features in order to bridge geographical and time boundaries. To create such systems which can bridge these gaps and at the same time, be flexible enough to merge with other systems, library systems need to switch over from traditional implementation to newer approaches. In recent times, Service oriented architecture and cloud computing are replacing the traditional client\server architecture in almost all areas of computing. By creating digital features and exposing those features

through web services, it is possible to create a universal repository of academic libraries and also allow sharing of intelligence over the internet. Using this approach, Universities will be able to Building a knowledge management system in its libraries that enables it to share common bibliographic data and resources with each other which will not only improve academic standards but also reduce cost.

The library has perceived the significance of recognizing, normalizing, and conveying shared models of library administrations (Dadhe et al., 2020), CISTI has been seeking after an inner Venture Architecture drive for north of three years. The models made and coming about administrations distinguished have been utilized to direct framework advancement, and are starting to convey on the guarantee of decreased duplication of improvement exertion, as extra assistance contributions can be based on the underpinnings of existing administrations.

Research Objectives & Questions

The following are the research objectives that may be explored as part of the project:

• To understand the need for migrating library systems from traditional approaches to service oriented architecture approaches along with the benefits of doing so for the academic libraries of Jazan University, Saudi Arabia.

• To identify the needs of features that can be provided by Building a simple and virtual knowledge system to facilitate collective intelligence.

• To merge the above 2 needs by Building a simple and virtual knowledge system based on the service oriented architecture approach having features like online conference rooms, interactive sessions, digital storytelling etc.

• To prove that this build a knowledge management system based on the analysis of the Service Oriented Architectural approach in the context of academic library digitalization will improve performance and efficiency of academic libraries as well as be open to easy enhancements and modifications.

• To prove that such systems were used by several universities/systems just by plugging in their own user interfaces such that it can help in creating a central repository for several libraries. This will open the doors knowledge management processes in academic libraries online.

Research Questions

The following are the tentative research questions that may be addressed as part of the project. These questions will be refined later on based on research and reviews:

• What is the SOA approach and why is it important for legacy systems to switch over to it?

• What are the gaps in current knowledge management in academic library systems that can be filled by using the SOA approach?

• What are the features that can be provided by build a knowledge management system based on the analysis of the Service Oriented to students through digital libraries and virtual learning platforms and is it possible to provide these features through an SOA based system?

• Will creating an SOA based knowledge management system help in improving efficiency of academic libraries and pave the way for interlibrary communications?

• Will it be possible for Universities to share common bibliographic / resource data using this system?

Intended tasks

The project will be divided into several tasks each of which will be carried out during one of the pre-decided phases. Some of the tasks which might be carried out as part of the project are:

- Gap analysis of existing system through primary and secondary studies.
- Literature review of SOA concepts and digitalization.
- Decision on tools and platforms, requirement finalization.
- Design and development of an improved system based on SOA.
- Evaluation and performance analysis.
- Write up.

Scope

The scope of any data gathered from participants for the purpose of gap analysis or requirement gathering will be limited to the members of the Jazan University. Any kind of primary data will not be gathered outside the university. The primary data will only be supplemented by secondary data gathered through research and reviews.

New computerized library frameworks and theirs design ought to pursue ways and directions of improvement in the area of organization data frameworks. As a matter of fact, it involves these ideas and standards:

• Administration arranged engineering (like Fedora).
• Process based methodology (like DSpace).
• Computerized processes including human work process.
• utilizing standard foundation and advancements.

(For example Venture Service Bus and so forth) In the space of computerized libraries these methodologies were not applied (aside from a couple of frameworks). One of the numerous potential outcomes how to accomplish high adaptability of the entire framework is to carry out a computerized library as a composite (SCA) application. Administration part engineering (SCA) is a somewhat new idea or system for making applications (composites) worked from administrations (Chatarji, J., 2004). Administrations are fundamental components of SCA composites which play out a particular work. Administrations might be executed utilizing unique innovations and programming dialects (Chatarji, J., 2004). SOA/SCA based design gives approximately coupled set-up of administrations which can decrease expenses of framework adjustment.

Literature Review

In the recent past, most of the applications in various fields have started switching over to the SOA approach of architecting from the traditional client-server approaches. While the concept of SOA has already been deployed successfully in several fields like e-Commerce, communication…. etc, it is relatively new in the field of academics in general and library systems in particular. While SOA is being explored in several areas of library functionalities including digital library initiatives (Dadhe et al., 2020), there have not been many full-fledged efforts or implementations of a truly SOA based library system.

SOA paradigm

Almost all the enterprise applications are made up of several distinct functions coupled with each other to provide a set of business services. The basic idea behind the SOA paradigm is that all the functionalities are treated as services. SOA (Figure 1) aims at organizing the distinct functions of the application into standards based service oriented architecture in which all the functions are exposed as services (Fasae, J. et al, 2020). This enables the functions to be exposed to the outside world as services thereby enabling reuse and opening multiple communications channels. Most of the services in the architecture are built using loosely coupled components. The basic implementation of SOA architecture can be visualized as follows (Chatarji, J., 2004):
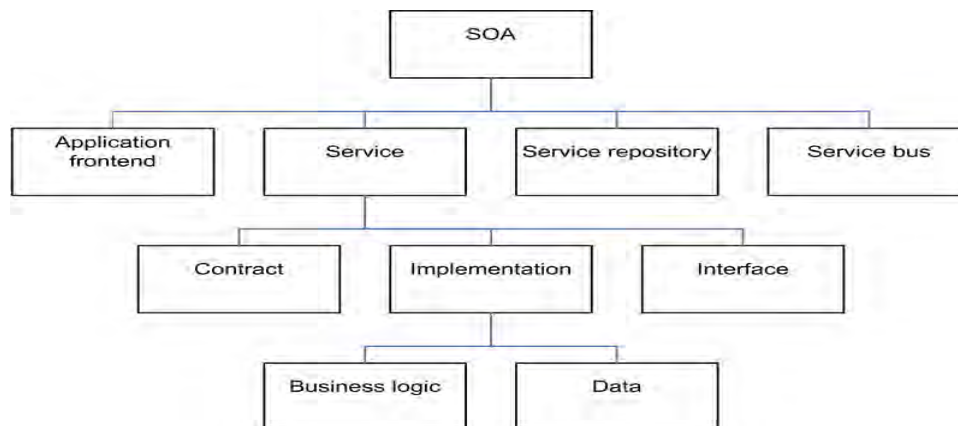
Figure 1. SOA architecture implementation

In a nutshell, SOA is a shift from object oriented programming to service oriented programming. SOA can be applied to the design of the technical architecture, business solutions and to the infrastructure (Hendal B., 2020) SOA architectures are made up of interfaces which are based on components and are well-defined to address specific business needs. The business solutions are created from these interfaces and services through combinations and reuse. The infrastructure allows the services to be exposed and accessed from the outside world. The basic principles behind the SOA paradigm are as given below:

• *Service or interface level abstraction* – The underlying implementation details of the services belonging to the solution are hidden from the outside world and just the signature is exposed. This is achieved by using service contracts.

• *Explicit service boundaries*- The services can be invoked and used through the details exposed through their contracts and no other information or assumptions are necessary to get the service working.

• *Loosely coupled* – The components and services are separate entities and all the services can work independently irrespective of the changes happening to other services. This is possible due to the fact that services share schemas and contracts but they do not share actual code.

• *Services are autonomous* – It is possible to change the underlying implementation details of a service without causing any impact to the users who are using it. This is possible because the services are autonomous and are exposed to the outside world only through their interfaces.

• *Services follow standard formats* – The basic idea behind SOA based approach is that the services should be accessible irrespective of the programming language and other details. Due to this, all the services follow a set of standard formats for communication, messaging, protocols etc.

• *Services are metadata driven* – All the information regarding the services like the descriptions, interfaces, endpoints, address, binding information etc is stored as metadata and the behavior of the services is driven by this set of metadata.

Advantages of SOA

The main advantage of SOA is the communication channels and bridges that it opens up. In standard approaches, creating a bridge between 2 applications is cumbersome and often leads to a haphazard, non-standard integration. Some of the major benefits of using an SOA based approach are outlined below:

Table 1. Advantages of SOA

Reuse	Using an SOA approach allows services to be reused and avoids the creation of same functionality multiple times by exposing it as a reusable service (Islam M.A. et al., 2014).
Incremental enhancements and adoption	New systems or features can be built on top of the existing systems as the approach uses loosely coupled components. Hence adapting new features or systems is much easier.
Composition	Services can be exposed through another layer on top of them which enables the services to be combined in different permutations and combinations to provide a variety of functionalities using the same set of functions (Islam M.A. et al., 2014).
Independence	Services and interfaces are exposed over the internet through their contracts and hence are accessible irrespective of their location and platforms. Therefore, they provide bridges between otherwise incompatible platforms and technologies (Karnieli-Miller., 2020).
Efficiency	The SOA approach reduces efforts and costs by allowing reuse and consolidation of code and services.

Application of SOA to library systems:

Academic libraries have a constant need to connect to systems outside their boundaries. They need to connect to technical websites and scientific journals. They need to connect to payment gateways for payment of fees and fines. They need to connect to other library systems in order to create and share knowledge repositories. In simple words, library systems need several bridges in order to perform up to their maximum potential.

Applying the SOA concepts to academic libraries is a powerful way of exploring the concepts of collective intelligence as most of the scientific and academic systems outside the context of libraries have started migrating towards SOA based approaches as their core.

Also, applying the SOA model to library systems is the way forward to improve OPACs by creating sustainable OPACs. Also, by networking with different applications, the range of data retrieved can be much higher. Using layers and concepts like mashups and widgets can create a large forum of collective intelligence.

Academic Library digitalization for Knowledge Management:

From the business or technical point of view, the need for academic library systems is to provide reusability and communication channels. However, from the end user perspective, the functionalities provided by the academic library system play a more important role. While most of the libraries do provide features like online access, remote logins and OPAC, they are still lagging behind when it comes to cutting edge technological features like online meetings and electronic whiteboards which can create a truly digital platform of learning. This is a serious shortfall in the library system that needs to be addressed so that the cutting edge technologies available can be used to the maximum possible extent. By allowing these features to be included as part of the library system, intercommunication and learning can be streamlined to a far greater extent and various avenues for learning can be created (Akerman R., 2007).

Digitalization of academic libraries in the traditional sense meant the conversion of physical copies of books into digital copies and the storage and retrieval of digital information. However, this no longer holds good in the present age. Digitalization has made huge strides and the options that

can be provided for academic learning are unlimited. Academic libraries themselves are shifting focus from information possession to access. There are several features that can be provided through library access to create virtual learning environments for students. Some of the features that are finding immense popularity in the outside world but are still unexplored in the world of academic libraries are virtual classrooms, online conferences, digital storytelling, electronic whiteboards, widgets, interactive digital sessions etc. Each of these features can provide a new avenue for learning and together implemented, they can change the face of academic libraries.

Digitalization for Digital Content through SOA:

The requirements for academic library systems are two-fold which can be broadly classified under the category of functional requirements and efficiency requirements. The functional requirements include the availability of new world digital features as explored in the previous section. The efficiency requirements include the availability of system across boundaries, intersystem communication, and adaptability of the system to new requirements and reuse of existing features for new business needs. The challenge is to provide the functional requirements while not compromising on the efficiency and performance. Towards, this end, the two aspects can be merged using the SOA approach.

As mentioned earlier, the SOA model allows the creation of efficient, extensible library systems which are able to interact with other systems outside their boundaries. However, the SOA approach can also be employed successfully to provide the digitalization of libraries by exposing and consuming service oriented functionalities.

It is possible to create a truly digitalized library system having all the latest features using the SOA approach. This is due to the fact that the SOA approach allows libraries to seamlessly connect with external resources and digital repositories. Features like online conference rooms and classrooms can be provided by allowing users to connect from multiple locations using the services exposed. Also by using data mashups it is possible to combine data from several sources to create an encyclopedia of data. It is also possible to create shared repositories of data, podcasts etc. By using these techniques, it is possible to improve the data contents in the library, create new avenues of learning like widgets and wikis and improve efficiency as a whole. Using an SOA approach will also make it possible to plug different User interfaces to the system with minimal effort so that one system can be used by many. Similarly, it is possible to connect to the system from outside by using the exposed web services so that interlibrary communication becomes possible and easy.

Methodology

This study will begin with an extensive study and analysis of information systems using the SOA approach. After that, a gap analysis of existing systems will be conducted to determine the features lacking in current system both technically and functionally. After establishing the gaps or shortcomings in the current system, a new system will be built to showcase the possibilities of an SOA based digital system based on the requirements established during the gap analysis. This analysis will be conducted based on the study of the existing system architecture and features as well as by gathering primary data within the Jazan University. All the requirements for the new improved system will be finalized based on koha implementation methods which enable a check listing and catalogue approach for some standard prioritization technique like MoSCoW.

Primary data gathering methods:

Primary data will be gathered from patrons of the University library. This might include the students who use the library in order to find out the digital features that they require and the library

staff members who define the business requirements of the system. Students might include long distance students as well if possible as they might benefit hugely from the introduction of digital classrooms and libraries. Also, the technical members of the staff who are responsible for the maintenance of the library system might be approached to gather data about the technical gaps.

For the purpose of data gathering, questionnaires based on standard format might be used. The responses obtained through these questionnaires might be supplemented either by face to face or focus group interviews. Any kind of data gathering tool will be piloted before using it for the actual study. The participants might be selected using random sampling techniques.

Here, total approximately 400 samples from multiple resources i.e employees, staff, male and female users including random choose from the libraries / online hubs of the related resources and after performing their interviews related to the questionnaire given in Table 2, the response has been quantified and floated to the focus group for comprehensive discussion on the samples keeping the dire needs and challenges upfront of digitizing the library resources with an ascertained eye globally. The following is the distribution of samples answers and focus group response in respect of the questionnaire:

Table 2. Questionnaire including sampled Answer and Focus Group Response / Level of Priority

Question	Sampled Answer	Focus Group Response/ Priority
Do any digitization of resources needs for the academic libraries using service approach?	298/400	Moderate
What kind of resources of you want to perceive to get in real-time (online)?	350/400	High
Do you think it will the spirit of age to develop or invest in the knowledge management system for libraries?	360/400	High
Do staff / employees will get real benefit from a library knowledge management system?	280/400	Moderate
Do you think, it essential for library systems to switch over online mode?	370/400	High
Do you think, it will be fair for Universities to share common bibliographic / resource data using this online system?	210/400	Moderate

Secondary Information Sources
For the purpose of gap analysis and requirement gathering for the new and improved system, the primary data will be supplemented by secondary data. This secondary data will be obtained by the following sources of information:

- Printed Journals (Copies in the library).
- Jazan University Databases.
- Online Resources (e.g. Technical blogs, websites, wikis, podcasts etc.)
- Technical and information system publications (e.g. the science library publications &other electronic libraries).
- Books and scholarly articles on the subject of library, knowledge management, information systems, digitalization, and Service Oriented Architecture approach.
- eBooks available through the internet and open resources.

Data Analysis:

In order to analyze patterns, raw facts and figures, groupings etc which might emerge as part of the data analysis, Standard statistical packages (SPSS) will be utilized in respect of service approach. In order to evaluate the qualitative data gathered, a software tool which aids in such analysis (like Nvivo) will be used to assist with response coding, analysis and theme derivation (Breeding M., 2006).

Proposed Development SOA based system Using Koha:

After establishing the gaps or shortcomings in the current system, a new system will be built to showcase the possibilities of a digital system of libraries of Jazan University. The new system will try to address the shortcomings established as part of the gap analysis along with the system will be based on the SOA approach that will be implemented as services and plug-in which can be customized and reused according to needs. All the functionalities will be exposed to the outside world as interfaces through service contracts.

Features to be included

All the intended features, enhancements along with the overall resources of the system will be designed and implemented based on the Service oriented architecture principles using Koha tool digital library system. As part of the study, the following features are intended to be included in the new proposed system which are detailed elaborated in section 4:

- *Integrative.*
- *Normative.*
- *Reliability.*
- *Inclusivity.*

The list of the features will be modified and refined as per need as the study progresses based on the research and the inputs received from the relevant users and library administrations.

Strategic Goals of Development:

The following will be the strategic goals for the development of the proposed system of Jazan University academic libraries:

- Application of modern technologies i.e Digital libraries of Jazan Univerity as a Central Node.
- Upgrading customer services to fulfill their academic needs
- Staff qualification Coach "Knowledge-able employee"
- Enabling the library to play its role towards university, society and research community
- Creating a managed knowledge based information enabled community
- Enriching information and developing content in managed means
- Build a knowledge management system based on the analysis of the Service Oriented Architectural approach in the context of academic library digitalization at Jazan University
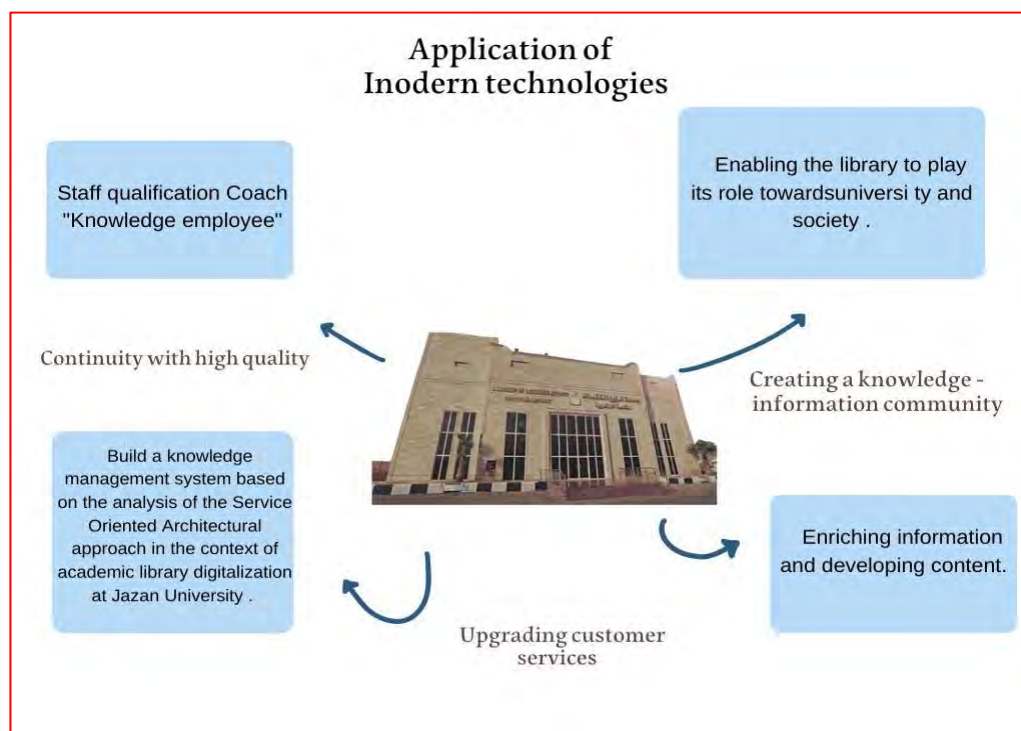
Figure 2. Strategic Goal of the Development

Approach and Technical Details

It is intended to use the koha tool platform for the design and development of the new system. Data migration tools will be used to classify, extract, analyze data and create diagrams as necessary relationships & patterns. The front end interface will be designed using the koha Integrated Development Environment (IDE) and its supporting programming languages. Microsoft SQL database will be used as the backend data online repository. Access to database will be through the entity framework using Ado.Net services. The services will be exposed as interfaces through the Windows Communication Foundation API provided by Microsoft. A graphical user interface might be designed using aspx or Silver light as per the requirements. Any other tools or technology needed will be decided as the study progresses depending on the need.

All the features of the system will be designed as component based services. Tentatively, it has been visualized that the new system will have separate services for data management, profile management, querying, requesting, online access/conferences and smart contents like knowledge sharing repositories. The services and features will be refined during the course of the study as needed.

Architecture layout:

The following is visualized interface as the preliminary network architecture diagram for the implementation of the integrated digital library system using service based approach and will be applied using Koha. In order to implement a centralized network, all the client nodes are pertained to be the as a end points of the library system which would integrated using a services provider to ping within the network as given as under:
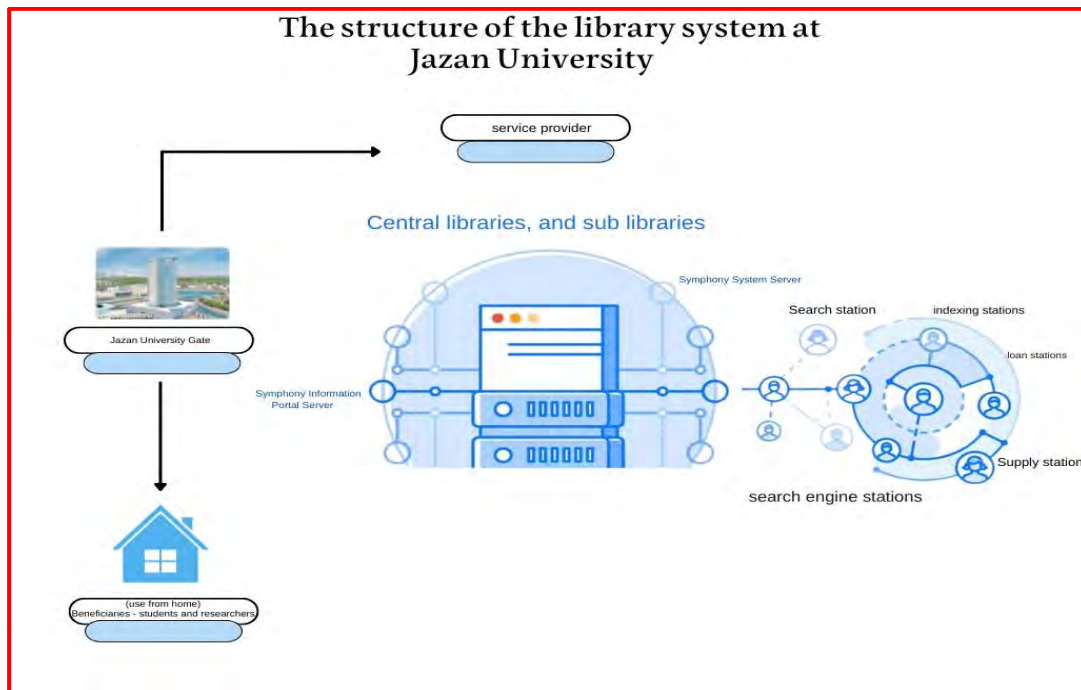
Figure 3. The Structure of Library System at Jazan University

The mentioned approach in Figure 3 and the architecture details in Figure 2 will be refined as the research moves further along based on the findings.

Results and Discussion
This section depicts the findings obtained from the all the phases of the reattach using the proposed methodology, literature review and data sources, the features of the system have been designed as component based services, samples and Koha implementation interface for Jazan University as shown in Figure 2. Uncertainly, it has been visualized from the interface, tables and graphs that the new system is having separate features includes SOA based services by implementation of and integrated library management system by applying Business Logic & data, all together forms knowledge, management, profile management, querying, requesting, online access/conferences and smart contents like knowledge sharing repositories.

Table 3. Advantages & Kind of services of the proposed system

Kind of Services	Proposed System Development will ensure
Integrative	*Different libraries will be able to use the same system with their own User interface and customizations thereby allowing them to interact with each other easily. This will make interlibrary communication*
Normative	*It will be very easy to change or modify the existing user interface*
Reliability	*It will help in creating a source of collective intelligence by creating online resources with its secure and due diligence access*
Inclusivity	*Users who cannot access physically to the resources of libraries and content due to health, distance, lack of interoperability & abstraction etc reasons*

Form our survey and SOA architecture; we have quantified the SOA implementation to get our desired results by the percentage based number so that services and features will be refined during the course of the study as shown in Table 3. This overall methodology and research process for the proposed work will follow the iterative steps and uses open source software Koha for future implementation and application which will provide the benefits as given in Table 3.

These features are beneficial not only from the technical and business perspectives but are also necessary and useful from the end user perspective. They will provide a much wider platform of remote learning and access for the patrons of the libraries:
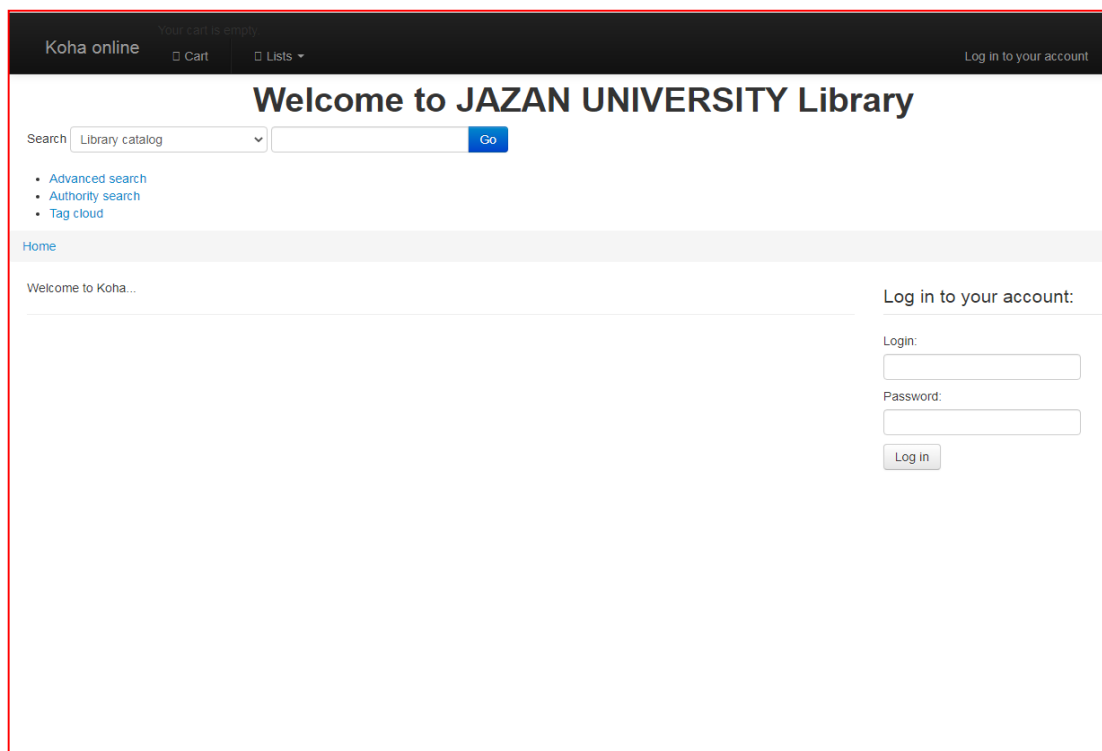

Figure 4: Graphical representation of web OPAC for searching resources of Jazan University Libraries

Once this will be implemented, the numbers have been quantified as percentage cut from the overall SOA implementation features, these can be more refined and analyzed to get the refined features which are necessary to move ahead for digitization formation of new leaning environment.

Apart from all, through applied features and methodology of data migration the resources type have been digitized and computed in order to obtain the results from the gathered data as given in Table 3, i.e, which includes the resources type digitization in terms of Services, Plug-ins and Customized on x-axis horizontally and SOA features on y-m axis vertically that enabled our work with features we have intended to include i.e Online class rooms & online conferences, Digital storytelling & electronic whiteboards & Creation on knowledge forums and wikis along with mobile interface:
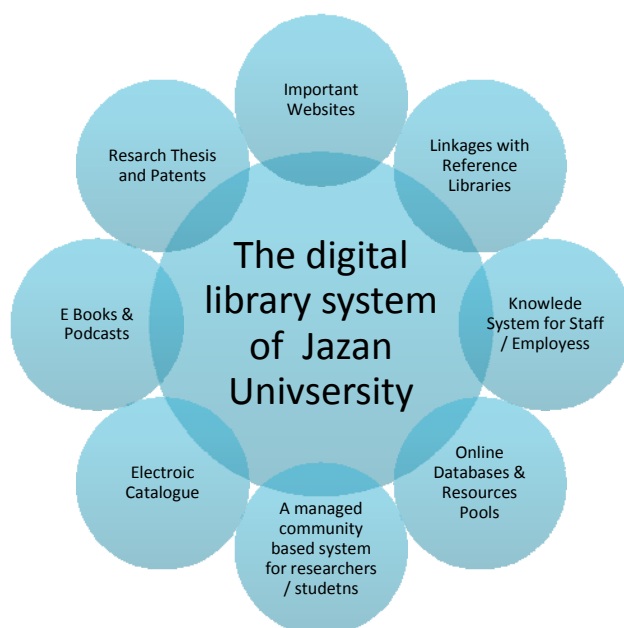
Figure 5. Graphical representation of services by new proposed Digital Library System of Jazan University Libraries

Table 4. Statistical representation of resources type for libraries of Jazan University

The reality of the holdings of Jazan university libraries in the academic year 2022 and their distribution according to their types							
he totalt		The number of foreign holdings		The number of Arab holdings		Collectibles type	M
folder and material	Title	folder and material	Title	folder and material	Title		
419637	183628	126,207	60898	293430	122730	**Arabic and foreign books**	**1**
3387	3387	181	181	3206	3206	**Arab and foreign periodicals**	**2**
56	56	-	-	56	56	**original manuscripts**	**3**
5824	5824	-	-	5824	5824	**government publications**	**4**
5870	5870	400	400	5470	5470	**Undergraduate Theses**	**5**
-	-	-	-	-	-	**audio aids**	**6**
-	-	-	-	-	-	**movie thumbnails**	**7**
						Electronic library	**8**
		1 subscription to the Saudi Digita 234 131862Library				**Other information bases**	**9**
628156	**193482**	**126788**	**61479**	**307986**	131862	**total**	

Based on above applied features, findings and proposed methodology during this work as given in Table 4, the graphical representation to visualize new proposed digital learning environment for libraries of Jazan University using acknowledge service is plotted in Figure 6, with new features inclusion i.e Search & Discovery, Dynamic Publishing, Personalization, User Management, Interests and SDI/Current awareness for creation a complete knowledge management system for improved user experience.
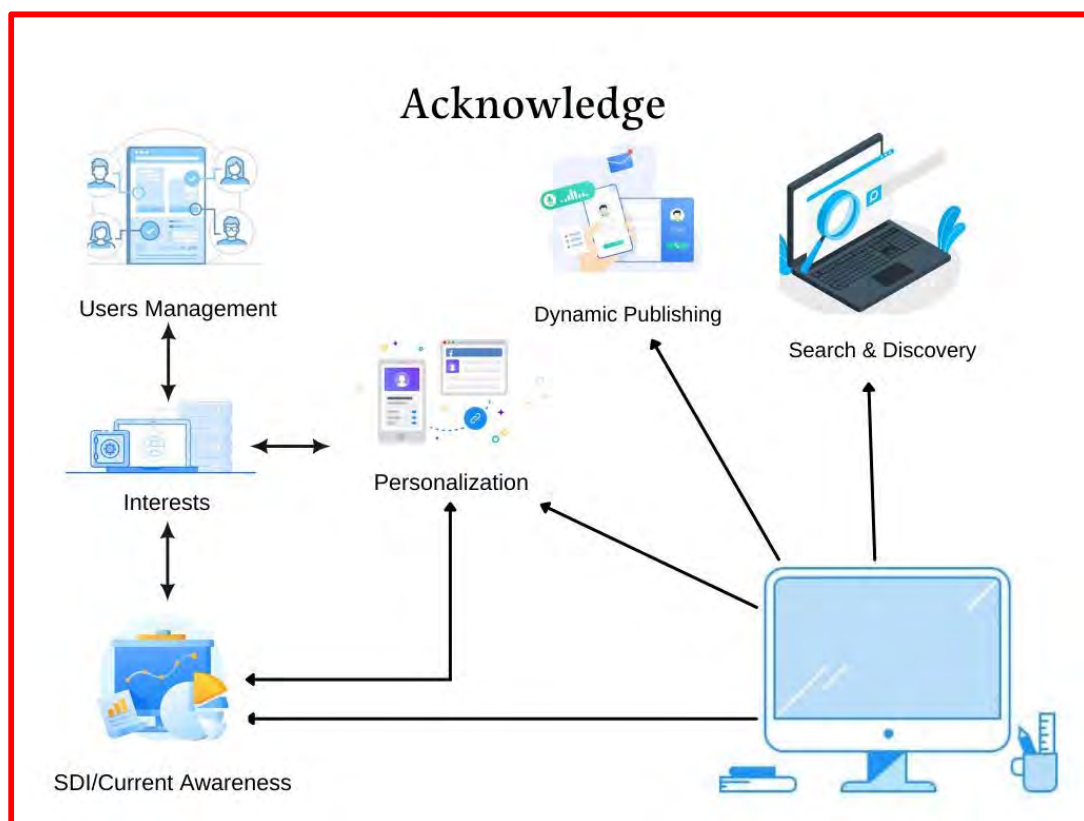

Figure 6. Graphical representation Digital Library access & learning environment for Jazan University Libraries Using Service acknowledge

This project has been divided into 3 phases based on initial analysis. The first phase will involve gap analysis of the existing system and research on SOA approaches and digitalization, wherein the SOA architecture got reviewed and visualized above in Figure 1. Based on that, findings were obtained by quantifying SOA implementation features as mentioned in Table 3 and plotted as Figure 4.

The second phase will involve the design and development of an improved system based on SOA and for that using the opposed mythology & research approach as shown in Figure 2. We have analyzed and reviewed the more improved Architecture Diagram drawn as Figure 3 which represents improved repository using LAN/network to engage the features of SOA with entity based relationships starting from Library repository and leads towards the end user passing more than a few framework interconnections.

Finally, the third phase will involve the testing, analysis and evaluation of the system and the same are obtained by applying the proposed data gathering techniques & questioners based survey mentioned in the methodology & research approach. Based on that, the Quantified digital learning environment for libraries using SOA has been sampled and graphically represented as shown in Figure 6.

The overall purposive intention is to deploy the new system over a web server such that it is accessible for testing by other students and staff of the Jazan university as shown in Figure 5, this will not only evaluate the academic activities but enables the end user to interconnect and interact with interactive, virtual based repositories and online features with storyboard and wikis. Finally, in this article there is extensively worked and specialized in the domain of library and information systems during the last 2 years as part of my research background as shown in Figure 6. Our more dissertation for was also on the subject of library systems wherein we conducted an extensive study on library systems in general.

Conclusion and Recommendations

The approach and the new proposed architecture recommends refined and new spirit of age features in respect of integrative, normative, reliability and inclusivity of the features of academic services provided by the Jazan University. As the research moves further along based on the findings, this proposal is the first step towards exploring the relatively complex area of library digitalization using a service approach. Since many of the library systems still use the traditional approaches for implementation of their systems, it is hoped that the outcome of this project will be beneficial not only for academic institutions of Jazan university and Saudi Arabia but also for the patrons of the library who are going to use the new features and the improved architecture. Also, the study intends to contribute towards the knowledge of academic library mergers and collective intelligence.

Apart from above, this project also recommends successful implementation of the new proposed system in terms of the extensive of services i,e online databases, cutting edge knowledge management system for real-time information for decision making and multiple literature / citation. The new improved system filled the gaps of present library issues which are decentralized, less informative and manual means. Further, the features provided a knowledge management system based on the analysis of sampled data and its level of priority focused by groups as high or moderate based system.

Lastly, the proposed system would improve the efficiency of Jazan academic libraries via interlinked, digitized and connected knowledge management system powered with multiple automated services and communications for the users in a client sever centralized approach. This system also provided the possibility to share the common resources keeping the secure resources active to the only authorized users by the staff who are having significant knowledge from the proposed knowledge management system.

References

Akerman, R. (2007, November 6). *Service oriented Architecture for libraries*. Retrieved October 5, 2010, from Science Library Pad: http://www.slideshare.net/scilib/serviceoriented-architecture-for-libraries

Breeding, M. (2006). *Web Services and the service-oriented architecture*. Retrieved October 6, 2010, from Library Technology Reports: http://www.worldcat.org/title/web-services-and-the-service-oriented-architecture/oclc/102372721

Chatarji, J. (2004, October 13). *Introduction to Service Oriented Architecture (SOA)*. Retrieved October 6, 2010, from Devshed: http://www.devshed.com/c/a/Web-Services/Introduction-to-Service-Oriented-Architecture-SOA/2/

Dadhe, P.P. and Dubey, M.N. (2020), Library services provided during COVID-19 pandemic: content analysis of websites of premier technological institutions of India, *Library Philosophy and Practice (e-Journal)*, p. 4445, available at: https://digitalcommons.unl.edu/libphilprac/4445

Fasae, J., Adekoya, C. and Adegbilero-Iwari, I. (2020), Academic libraries' response to the COVID-19 pandemic in Nigeria, *Library Hi Tech, 39*(3).

Hendal, B. (2020). Kuwait university faculty's use of electronic resources during the COVID-19 pandemic, *Digital Library Perspectives, 36*(4), 429-439.

Islam, M.A. and Hossain, M.J. (2014), Marketing information resources and services on the web, *The Electronic Library, 32*(5), 742-759.

Karnieli-Miller, O. (2020). Reflective practice in the teaching of communication skills, *Patient Education and Counseling, 103*(10), doi: 10.1016/j.pec.2020.06.021.

Talis. (n.d.). *Opening the Walls of the Library*. Retrieved October 5, 2010, from SOA and web services at Talis: http://www.talis.com/integration/documents/talis_SOA_white_paper_august_2009.pdf