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Using integrated library management systems for the improvement of information services based on cloud computing

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ABSTRACT

With the rapid increase in global intellectual production, academic libraries have been challenged to make this product available to beneficiaries at the perfect time and place. On the other hand, the rapid development in the field of information technology, especially cloud computing and open source software applications, offers many capabilities that can be harnessed in the work of academic libraries to meet the needs of beneficiaries. This paper aims to developing information services in the academic libraries in University of Diyala (UOD) through using cloud computing applications and open source software (Koha) to facilitate the search and retrieval of information by librarians and beneficiaries. A unified research platform has been created for all academic libraries at UOD using Koha integrated system and building a database of bibliographic records, which have been installed on the Google cloud platform. The unified search platform helps librarians and users retrieve information and search resources more efficiently from anywhere, at anytime by calling sources of information with multiple retrieval points (author, source, ISBN, abstract, keywords) as well as the ability to search for sources of information in all UOD libraries simultaneously, which contributes to reducing the time of the beneficiary in obtaining sources of information.

1. Introduction

Academic libraries pursuit to fulfill their responsibilities and to achieve excellence in all aspects of the university educational system. But the former ways of managing libraries show a clear weakness in the provision of services to beneficiaries. To solve this problem, new technologies should be exploited, such as integrated open source software in library management (Koha) and cloud computing [1]. Open source software is a free software licensed to users with the freedom to run the software for any purpose[2]. The open source system is an exciting opportunity for academic libraries rather than forcing libraries to use proprietary software that may not meet all their needs. It allows the library to participate directly in the development of its systems and service innovation that serve users' needs in a way that is consistent with the values of libraries.

On the other hand, the increasing demands for accessing intellectual production and services of academic libraries, force libraries to turn their sights on a new internet-based computing model. Cloud

computing is a new technology model that provides new ideas and solutions in various fields; including the field of academic libraries. Cloud computing provides the effective integration and sharing of data, software, and hardware resources on demand to computers[3]. The use of cloud computing increases efficiency, reduces financial expenses and reduces maintenance costs and manpower because cloud computing doesn't require any hardware or software requirement. It will improve user experience, will help make academic libraries more scalable and contributes to the effective management of the academic libraries, its services and resources.

There are many previous studies that dealt with the subject of paper from other aspects. In [4], the study looked at Koha's features and assessed his experience in building a direct catalog at the University of Neelain library. The study highlighted the open source software that can be used in information institutions, archive centers and libraries, as well as a study of the Koha system and its level of application

in the University of Niles Library and the creation of a direct catalog of the academic library. The study came out with a set of results, the most prominent of which was that Koha integrated library system provides many important services for libraries and archive centers where there are no integrated systems and one of the most important services is a local content support service, where the system was distinguished by providing an imaginary shelf service that helps the user to browse the library through direct index.

While [5], dealt with the identification of open source software and the possibility of investing it in the computerization of Iraqi university libraries in addition to identifying the readiness of libraries to shift from single-application systems to integrated systems by identifying the stages in which university libraries can be computerized, and the possibility of investing in open source software (Koha) in university libraries instead of Winisis. The most prominent results of the research were the absolute dependence of the Iraqi university libraries on the Winisis system and did not perform comprehensive computing procedures other than converting the card indexes into automatic indexes.

2. Problem Statement

Despite the development in the field of information technology, especially in cloud computing applications and open source software that provide great potential in the development of information services in libraries, many academic libraries at the UOD suffer from a decline in the level of information services provided to beneficiaries. In UOD, most of the information services provided to the beneficiaries (such as Acquisition Service, retrieval information, catalog service, library lending services, reports service) are provided in a traditional paper-based manner. In addition, the academic libraries in UOD operate in a unilateral and non-integrated manner, as each library provides its services to the beneficiaries

in a way that is independent of other libraries in the same university. In addition, information sources in each library classified separately by the type (thesis, book, magazine) and by specialization (physics, computer science, mathematics), this causes a lot of confusion and delay in retrieving information sources due to having to search for information in several indexes. This method of executing business costs librarians and beneficiaries more time and effort to retrieve information and meet their needs, which will, in turn, negatively affects the level of effectiveness and efficiency that these libraries aspire to access.

3. Research Objectives

The research aims at achieving the following objectives:

1. Description of Koha Open Source and cloud computing.
2. Implementation and use of Koha integrated library management system on the cloud computing platform.
3. Create a unified electronic platform for the libraries of the UOD.
4. Facilitate the search and retrieval of information by reducing effort, time and cost.
5. Developing information services provided by UOD libraries to beneficiaries according to their needs.

4. Research Method

The research adopted the descriptive and analytical method along with the experimental method for they suit the nature and the preparation of the research. This included the installation of the integrated library management system (Koha) on cloud computing platform and building a bibliographic database.

5. Research Sample

The research sample comprises of the UOD libraries in its various faculties and research centers as shown in table (1):

Table 1: Libraries of faculties and research centers in UOD.

No.	Library	No.	Library	No.	Library
1	General Secretariat of the Central Library	7	Library of the Faculty of Agriculture	13	Library of the Faculty of Arts
2	Library of the Faculty of Basic Education	8	Library of the Faculty of Medicine	14	Library of Al-Miqdad Faculty of Education
3	Library of the Faculty of Education for Humanities	9	Library of the Faculty of Veterinary Medicine	15	Library of Childhood and Motherhood Research Center
4	Library of the Faculty of Physical Education	10	Library of the Faculty of Engineering		
5	Library of the Faculty of Education for Pure Sciences	11	Library of the Faculty of Law and Political Science		
6	Library of the Faculty of Science	12	Library of the Faculty of Management and Economics		

6. Open Source Software

Open source software is a software that is distributed with a source code that can be read or modified by users, unlike traditional software which are distributed in non-modifiable compiled format [6].

The use of open source software has several strategic dimensions that can be summarized as follows [7]:

1. Economic dimension: Open source software contributes in lowering costs, developing local competencies, and avoiding duplication of software building efforts.

2. Leadership: Open source software comes to bridge the gap between the countries of the West and the East, as the West has become a true leader in the field of science, knowledge and innovation through the large use of open source software because it provides them with real opportunities to learn about the latest technologies and software.

3. Support: Open source software can support various standard and non-standard file formats, known as compatibility formats data.

4. Collaborative dimension: Open source software, being free, encourages participation of source code. In the field of libraries and information, there are several advantages in using open source software [8], [9]:

1. Supports several universal languages.
2. Saves software cost.
3. High flexibility.
4. Rapid development, support and deployment.
5. Supports importing and exporting of bibliographic records from different systems.

7. Koha

Koha is a browser-based automated library management system. The system was designed and developed with Server/Client architecture via a group of programmers, designers and librarians and was piloted for the first time in January 2000 [10]. It enables the ability to handle, store and retrieve audiovisual and digital information sources [1]. Koha comprises many key features[11]:

1. The program is free; it doesn't cost any money.
2. The ability to develop and remove errors effectively by programmers and librarians around the world and make the program available to use by any user.
3. An integrated library system that provides many library services to ensure carrying out all modern library activities.
4. Supports working in the World Wide Web environment.
5. Specially designed to work in the library environment and was prepared by a group of specialists in the field of libraries.
6. Supports 46 universal languages.

7.1. Information Services in Koha:

Koha provides many library and information services. Information services are defined as the end product that a library user receives in the right time, right way and right format[12]. These services can be described as follows:

7.1.1 Cataloging Services: include several sub-services

- a. Indexing different types of information sources (books, periodicals, theses, audiovisual materials... etc).
- b. Collaborative indexing services through the use of the z3950 standard, which allows access to international libraries in case a user wishes to obtain bibliographic records ready to be imported.

c. The ability to import and export bibliographic records to and from Koha: librarians find themselves unable to convert their libraries to the system because of the time it consumes in converting bibliographic records into the system, but Koha has solved that problem through the system's ability to import and export files.

d. The possibility of adding any source of information in a special basket in the search interface.

e. The possibility of booking information resources online.

f. The possibility of identifying lost or loaned books.

g. The possibility of alerting and notifying the beneficiaries of the end of the loan period.

h. The possibility of determining the amount of fine imposed on the beneficiary.

7.1.2. Reporting Services: include several sub-services:

- a. Reports on monthly or annual loans.
- b. Reports on the most repeatedly loaned resources.
- c. Reports on the most benefited clients.
- d. Reports on the academic disciplines which are of interest to researchers.
- e. Reports on missing items.

7.1.3. Search (Information-Retrieval): it is one of the most important services offered by Koha to the beneficiaries, including:

- a. Multiple methods of information retrieval (author, title, subject, year, classification number, series, co-author, translator, index).
- b. Simple search and advanced search: The beneficiary can search in one of the colleges individually or search all university libraries at once to find the appropriate sources of information and thus affords the freedom to choose the right place to obtain sources of information.

c. Online Information Retrieval.

7.1.4. Acquisitions Services: these comprise the following sub-services:

- a. Contact publishers and send purchase orders to suppliers.
- b. Searching for pre-purchase activities.
- c. Purchase suggestion files.
- d. Searching within the desired address.
- e. Building a file with suppliers and publishers.
- f. The possibility of submitting proposals by the beneficiary to purchase resources through an electronic interface found in the search interface.

7.1.5. RSS Services: it is a news service that works through the beneficiaries' emails and preferences in order to enable the beneficiary to obtain information at the moment of arrival, or by placing a box under (newly arrived) in the patron's interface. This service provides an ongoing briefing feature for beneficiaries who have specific interest in some resources, or it can be used for the purpose of notifying the beneficiary of the arrival of new resources in a particular library and thus the possibility of making use of those resources as quickly as possible[13].

7.1.6. Periodical Services: one of the key services in various libraries, which can be used to know the available issues of those periodicals, or that the institution wishes to subscribe and to determine the type and level of preferred subscription.

7.1.7. Identity Cards Services: provides the possibility of substituting paper-based Id cards for the beneficiaries with electronic ones in a format that can be designed as desired by the institution.

7.1.8. Add a Comment Service to Any Resource of Information in the Search Interface: it is one of the distinctive services which allows the beneficiaries to add any comment they see fit on any material or bibliographic record found in any library in the university (after system administrator authentication).

7.1.9. Content Evaluation service: the beneficiary can evaluate any source of information in Koha as the evaluation consists of (5) degrees (stars).

8. Cloud Computing: An Overview

According to National Institute of Standards and Technology (NIST) "Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction[14]. That is to say, cloud computing is a collection of hardware, software and information that are used to assemble on-demand solution and can be accessed over the network (Internet) [15,16]. The cloud model in figure (1) composes five essential characteristics, three service models, and four deployment models."

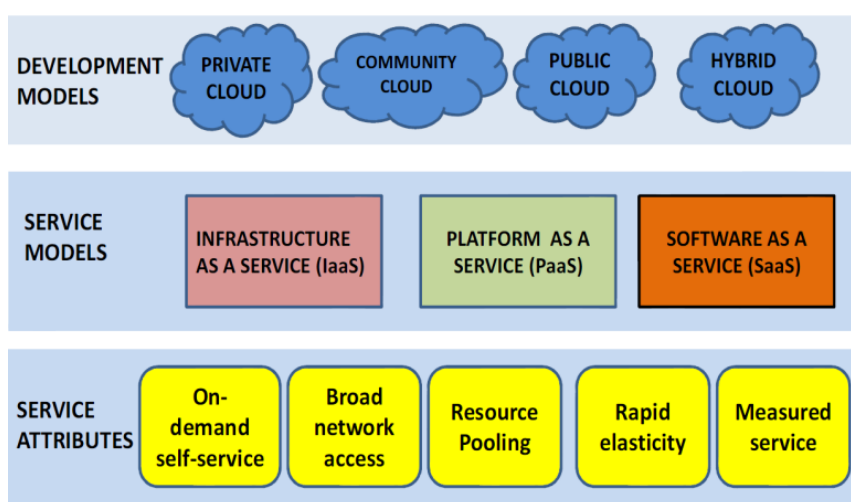


Fig. 1: The NIST Cloud Computing Definition [17]

8.1 Cloud Computing Deployment Models

There are four cloud deployment models:

1) Private Cloud

Private cloud serves a single organization which comprises multiple consumers. Private cloud may be present either on or off premises. It may be owned, managed, and operated by a third party, by the organization itself, or by a combination of them[18].

2) Community Cloud

Community clouds combine many organizations with shared concerns. Community clouds may be owned, managed, and operated by a third party, one or more of the organizations, or by a combination of them. It may be present either on or off premises[19].

3) Public Cloud

In Public cloud, many organizations can own and operate business on the same cloud via public internet to obtain cloud services [20].

4) Hybrid Cloud

A hybrid cloud is a composition of two or more public, private, or community clouds which retain their unique identities but are bound together by a proprietary or standardized technology that ensures data and application portability [18].

8.2 Cloud Computing Service Models

Cloud computing can be divided to three different models[21,22,23]:

Infrastructure as a Service (**IaaS**): cloud user is renting computers, as a physical or virtual machine, and other resources (IP address, load balancers, virtual local area networks, etc.).

Platform as a Service (**PaaS**): cloud provider offers operating system, programming languages, database, execution environment, and web server. Application developers can use a cloud as a platform to develop and run their applications.

Software as a Service (**SaaS**): cloud user can use the application software that is installed and operated by cloud provider over a network (Internet).

8.3 Essential Characteristics of Cloud Computing

Cloud computing comprises five essential characteristics [18,24]:

1) On-demand Self-Service: A customer can use cloud as needed without requiring human interaction with the cloud provider.

2) Broad Network Access: services can be accessed over the internet by any of client platforms (laptops, smart phones, workstations).

3) Resource Pooling: cloud provider can share computing capabilities to serve multiple customers, leading then to increase resource utilization rates through the use of virtualization technologies.

4) Rapid Elasticity: cloud can elastically provide and release computing capabilities to rapidly scale in order to commensurate with the growth in demand.

5) Measured Service: the provider and consumer can monitor, control, and report the utilized service for billing purposes.

8.4 Benefits of Cloud Computing in Academic Libraries

The benefits of cloud computing in academic libraries include the following[25,26]:

- Saving implementation and maintenance costs
- Flexibility and innovation
- Scalable and elastic infrastructure
- Availability anytime, anywhere
- Transparency
- Connect and converse
- User centric
- Representation
- Openness
- Interoperability
- Create and collaborate

9. Implementation of a Unified Research Platform

The implementation task consists of two parts; firstly, the establishment of a cloud computing platform type PaaS on the Google cloud platform and the installation of Koha. Secondly, the design of a unified interface for the libraries of the UOD.

9.1 Cloud Computing Platform

In this paper, a cloud computing platform was created on the Google cloud platform where a Virtual Machine (VM) Instance was created with the following specifications:

- CPU: 2 vCPU, 7.5 GB memory.
- Operating System: Debian GNU/Linux 9 (Stretch).
- Boot Disk Type: SSD persistent disk.
- Boot Disk Size: 40 GB.
- Firewall: Allow HTTP traffic, HTTPS traffic.

After establishing VM Instance, Koha 18.11.8 was installed.

9.2 Design of a Unified Interface for UOD Libraries

Koha must be accessed using the admin login interface as shown in the figure (2).

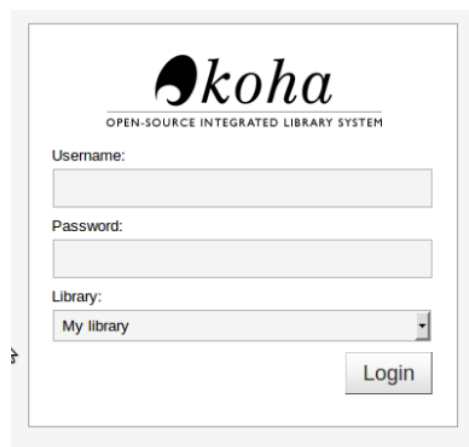


Fig. 2: Koha login interface

After login, a unified interface was created for each one of the 16 academic libraries in UOD to be used by librarian as a data entry platform, as in figure (3):

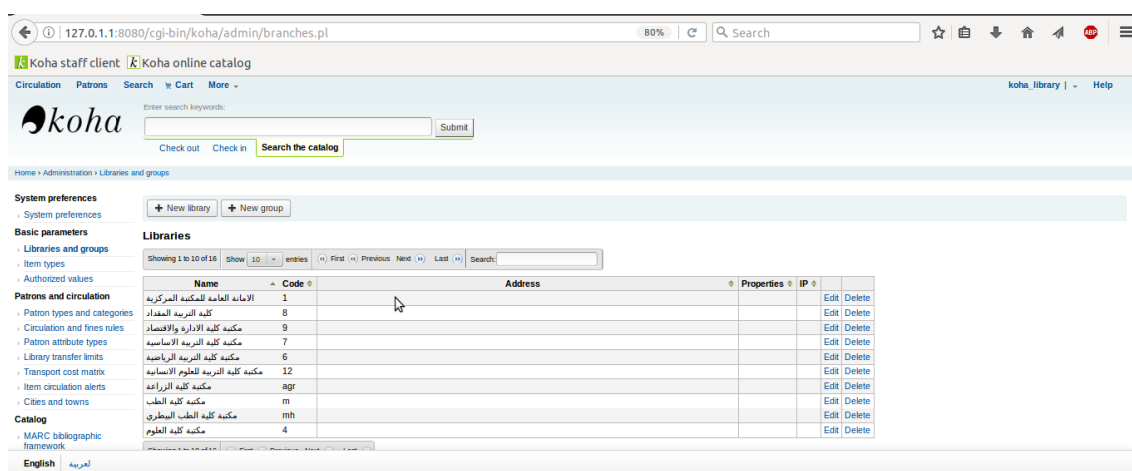


Fig. 3: Koha unified interface for UOD libraries

Moreover, user accounts were created for each library to be able to include its bibliographic records in the system to make it available in the user interface. The researchers also designed a Koha interface using HTML. In addition, in order to speed the retrieval of

information sources by the beneficiary on one a unified search platform, a search engine has been added to search bibliographic records within a specific library or all libraries at the same time, as shown in figure (4).

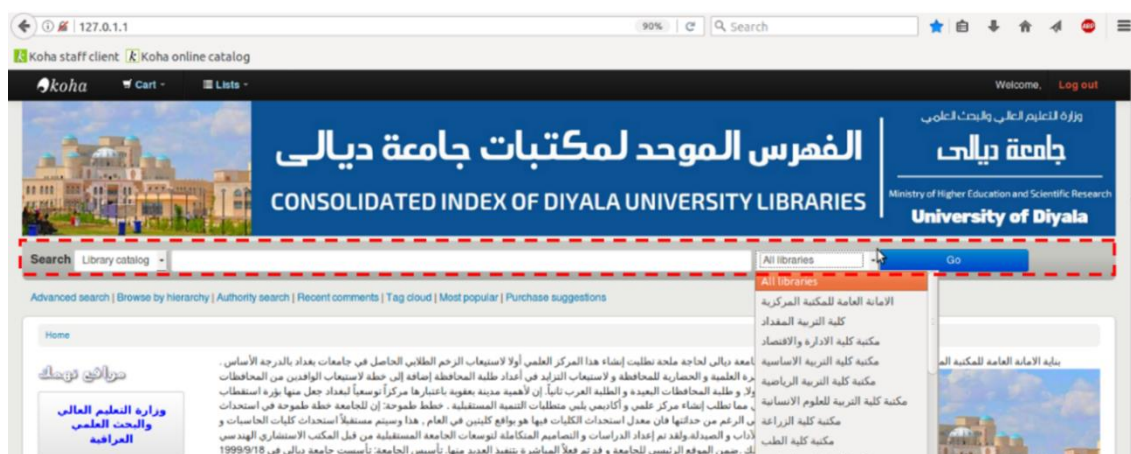


Fig. 4: The Unified search engine in the user interface

With the proposed system, the beneficiary can search for the source of information online (at anytime, from anywhere) by title, subject, author, series number, classification number, ISSN, ISBN. These options make the UOD libraries to work within a unified platform that saves researchers' time and effort. Figure (5) shows an example of information retrieval on the keyword "Information". On the left side it shows authors' names of all bibliographic records retrieved, which makes it easier for the beneficiary to

choose the required author and to move directly to the requested source. Next, all university libraries have the same source of information in the sense that the requested source is located in more than one library and the beneficiary can choose the library that suits or be close to him/her. This is followed by the type of information sources retrieved, whether they are books or reference sources. Furthermore, the desired source can be saved in a beneficiary's own basket.

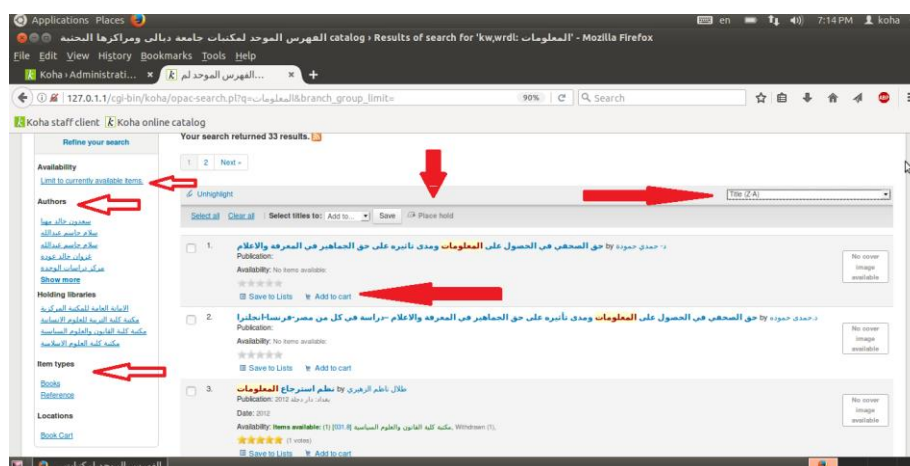


Fig. 5: information retrieval interface

10. Conclusions

A unified platform for UOD libraries was created using Koha software and cloud computing platform. Virtual machine was created on Google's cloud computing platform. The Koha integrated library management software is installed on the virtual machine of cloud computing. In addition, a dedicated interface has been created for each library to enable librarians to manage all library services. The unified platform enables both librarians and beneficiaries to access and retrieve information based on bibliographic information in the Koha database. Beneficiaries can search for any source of information anytime, anywhere, in one library or in all libraries simultaneously and find out which library in which the information source is located is nearest to the user.

The proposed platform provides beneficiaries with the ability to search for information sources in all university libraries with multiple retrieval points and view bibliographic information for the sources, as well as allow users to reserve information sources or even suggest new information sources for the purpose of providing them by libraries.

On the other hand, the platform allows libraries to know the full statistics on the sources of information and the beneficiaries alike, which helps libraries to improve the services provided to the beneficiaries.

Researchers recommend UOD's officials and decision makers to apply the proposed system in the university libraries to take advantage of modern technologies, especially open source software and cloud computing and to end the using of traditional methods in the management of academic libraries.

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استخدام نظم إدارة المكتبات المتكاملة لتحسين خدمات المعلومات بالاعتماد على الحوسبة السحابية

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المخلص

مع الزيادة السريعة في النتاج الفكري العالمي، تواجه المكتبات الأكاديمية تحديًا لجعل هذا النتاج متاحًا للمستخدمين في الوقت والمكان المناسبين. من ناحية أخرى، يقدم التطور السريع في مجال تكنولوجيا المعلومات، وخاصة الحوسبة السحابية وتطبيقات البرمجيات مفتوحة المصدر، العديد من القدرات التي يمكن تسخيرها في عمل المكتبات الأكاديمية لتلبية احتياجات المستخدمين. تهدف هذه الورقة إلى تطوير خدمات المعلومات في المكتبات الأكاديمية في جامعة ديالى من خلال استخدام تطبيقات الحوسبة السحابية وبرمجيات المصدر المفتوح (كوها) لتسهيل البحث واسترجاع المعلومات من قبل أمناء المكتبات والمستخدمين على حد سواء. تم إنشاء منصة بحث موحدة لجميع المكتبات الأكاديمية في جامعة ديالى باستخدام نظام كوها المتكامل وبناء قاعدة بيانات للسجلات الببليوغرافية التي تم تثبيتها على منصة Google السحابية. تساعد منصة البحث الموحدة المكتبيين والمستخدمين على استرجاع المعلومات وموارد البحث بشكل أكثر كفاءة من أي مكان وفي أي وقت عن طريق استدعاء مصادر المعلومات مع نقاط استرجاع متعددة (المؤلف، المصدر، رقم ISBN، المستخلص، الكلمات المفتاحية) بالإضافة إلى القدرة على البحث عن مصادر المعلومات في جميع مكتبات جامعة ديالى في وقت واحد، مما يساهم في تقليل وقت المستفيد في الحصول على مصادر المعلومات.