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Electronic document management system for local area network-based organizations

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ABSTRACT

The paper discusses the design and development of an electronic document management system (EDMS) that prepares documents for sharing and information dissemination. EDMS has to do with capturing, storing, indexing, retrieval, and disposal of documents. The electronic document management system process starts by converting paper document into digital record to efficiently store and organize document in standardized file structure and format, promoting a paper waste reduction in reproducing the document. The EDMS provided an easier way of sharing information with different stakeholders and securing documents according to standardized compliance rules. The developed system has also improved the accessing of vital documents by users since there is real-time information distribution of information and easy searching and retrieving of needed documents.

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1. INTRODUCTION

An organization needs rapid and accurate dissemination of information to its stakeholders. In this era of digital society, files are usually generated using computers, and copies are reproduced for information sharing. The reproduction of bulk documents may add up to the operational cost of an organization [1]. An electronic document management system (EDMS) offers a solution to this challenge by enabling the preparation, upload, and sharing of documents with different users [2], [3]. The use of EDMS in various sectors, including universities [4], government [5], municipal units [6], and organizations, has been shown to reduce operational costs, increase work efficiency, and promote collaboration among stakeholders. With the use of EDMS, documents can be easily accessed, searched, and retrieved in real-time, and multiple users can work on the same document simultaneously, facilitating communication and connections between different documents [7], [8]. The implementation of EDMS in an organization has the potential to revolutionize the way information is managed and shared [9].

The implementation of electronic document management system in government has brought operational efficiencies in administration. EDMS provides access to real-time information through its document storage, retrieval, workflow facilities, auditing, searching and publishing features [10]. Additionally, the use of EDMS has resulted in cost savings for organizations as it reduces the spending on paper documents and overhead staff time for producing and distributing information. This shift towards digital document management has brought a change in the corporate culture and resulted in increased income for organizations [11], [12].

The effective management of documents is essential in any organization, as they are crucial for various purposes such as record-keeping, communication, and decision-making [13], [14]. Despite the availability of

electronic document management systems, they often lack integration and fail to meet the demands of organizations. In response, a new office system has been designed and developed to provide practical and efficient man-machine interfaces, integrated facilities, effective database management techniques, and support for various types of data [15]. The system offers robust and reliable services for document creation, editing, deletion, and searching, enabling users to access and manage their documents with ease [16].

Moreover, the implementation of electronic document management systems in educational institutions has proved to be beneficial, especially for students and faculty members. This system facilitates communication between students and the school regarding their theses, leading to more efficient and effective use of time. By saving time and streamlining processes, students and faculty members can focus on other productive tasks, resulting in an overall increase in productivity [17].

An efficient document management system is crucial for the smooth functioning of an organization. The research focuses on the design and development of an electronic document management system that streamlines the process of document preparation, sharing, dissemination and archiving. EDMS involves capturing, storing, indexing, and retrieval of documents, resulting in improved access and retrieval of information by the users. The EDMS converts paper documents into digital records and stores them in a standardized file structure and format, promoting paper waste reduction and efficient document organization. The system also facilitates the secure sharing of information with stakeholders, ensuring compliance with established rules and regulations. By providing real-time access to information, the EDMS saves time and increases the efficiency of the users, contributing to the overall productivity of the organization.

2. METHOD

The design and development of an electronic document management system was carried out using the rapid application development (RAD) methodology, as depicted in Figure 1. The RAD methodology consists of four phases, including requirements planning, system design, construction, and cutover, which were all executed in an agile and iterative manner [18], [19]. By involving the end-users in the development process from the planning stage, their requirements and feedback could be effectively integrated into the system. This helped in creating a system that met their needs and increased the speed of development [20], [21]. The RAD methodology allowed for a more user-centered approach and ensured that the system was developed efficiently and effectively.

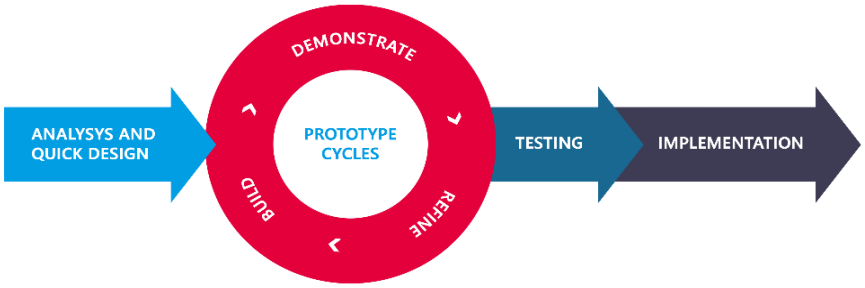


Figure 1. Rapid application development model

2.1. Analysis and quick design

The process of the electronic document management system is shown in Figure 2. It starts with the receipt of an internal document that requires distribution to all employees or offices. The document is stamped and recorded by the records office and then scanned to create a digital file. The EDMS records important details such as the date, reference number, file number, confidentiality level, author, and disposal date. This information is then saved, and the digital file is uploaded to the system for distribution to authorized users. By using the EDMS, the document can be easily viewed and downloaded by the relevant users, streamlining the process of information dissemination.

2.2. Testing and implementation

The electronic document management system was thoroughly tested for its functionality, user interface, and performance. The tests were conducted in a simulated environment and provided valuable insights into the strengths and weaknesses of the system. The results of the tests showed that the system met the requirements and expectations of the stakeholders, providing a fast, efficient, and secure way to manage

and disseminate documents within the organization. After the successful testing phase, the EDMS was implemented in a university and has been used as the standard tool for managing documents in the institution. The system has been well received by the employees and has resulted in improved work efficiency and reduced operating costs for document management and dissemination.

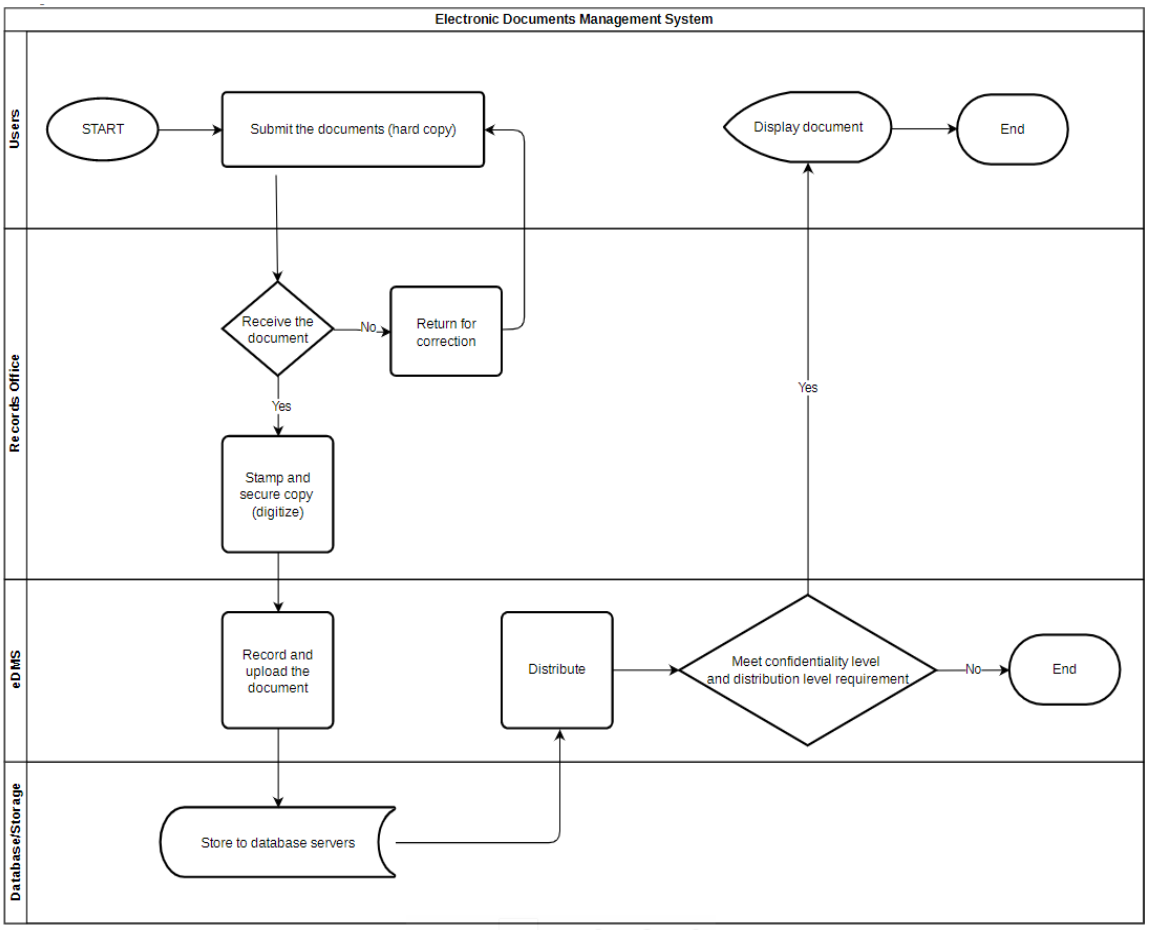


Figure 2. Process of the electronic document management system

The system was developed using visual studio 2015 and the ASP.Net C# programming language, along with SQL server 2016 as the database. Figure 3 illustrates that the system operates in a local area network (LAN) environment, with the EDMS application installed on employees' workstations to receive and view distributed documents, while the application software is stored on a central file server for easy updates. The database server functions as the central repository for all digitally converted documents, securely storing important records, and making them easily accessible for authorized users. The implementation of the EDMS significantly improves the efficiency of document management and dissemination processes, leading to increased productivity and reduced operating costs.

2.3. Evaluation

The effectiveness of the developed EDMS was evaluated through a user acceptance testing (UAT). The evaluation was performed to ensure that the system met the requirements and expectations of the end-users. The assessment was carried out using the International Standard Organization 9,126 software evaluation questionnaire, which is a widely recognized standard for measuring software quality in terms of functionality, efficiency, reliability, and usability [22], [23]. The end-users were asked to rate the system using a likert scale, as shown in Table 1. Pilot testing and trial runs were also conducted to provide hands-on experience for the respondents and further assess the system's performance.

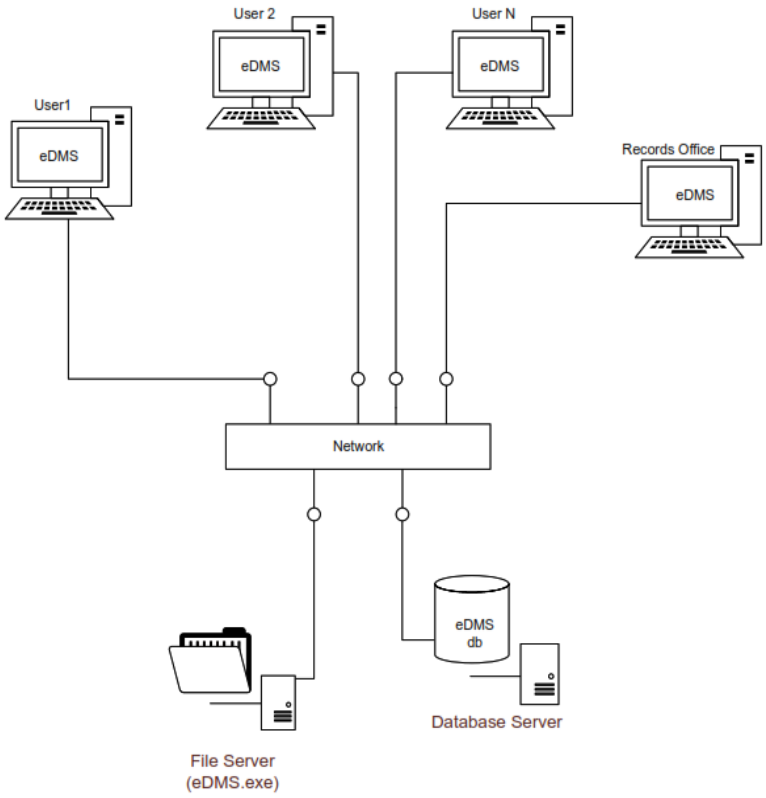


Figure 3. Network set-up for EDMS

Table 1. Likert scale

Mean Value	Weight	Verbal interpretation
4.51–5.00	5	Outstanding
3.51–4.50	4	Very satisfactory
2.51–3.50	3	Satisfactory
1.51–2.50	2	Good
1.00–1.50	1	Poor

3. RESULTS AND DISCUSSION

3.1. Use-case diagram of the electronic document management system

The use-case diagram of the electronic document management system is shown in Figure 4. It illustrates the main functionalities and actors in the system, including the document viewer, document distribution, and document storage. The document viewer allows users to view, bookmark, search, and filter documents, providing quick access to the information they need. The document distribution module allows the system administrator to manage the distribution of documents to employees and offices, including creating, updating, deleting, and disposing of document records. The document storage module provides a secure location to store and save the scanned files received from the records office, serving as the central repository of documents in the system. This use-case diagram provides a comprehensive overview of the EDMS, making it easier for users to understand the system's functionality and how it can benefit them.

3.2. Document distribution

The document distribution module in the electronic document management system is used by the administrator to prepare documents for distribution to recipients. Figure 5 illustrates the process: when a new document is received, the administrator creates a record with information such as the date of release, reference and file numbers, confidentiality level, author, and subject. The record is tagged with an identifier to allow easy identification of the document. The document is also assigned a disposal time based on records management policies. Only the users within the specific office tagged in the document during distribution can view the document in the document list.

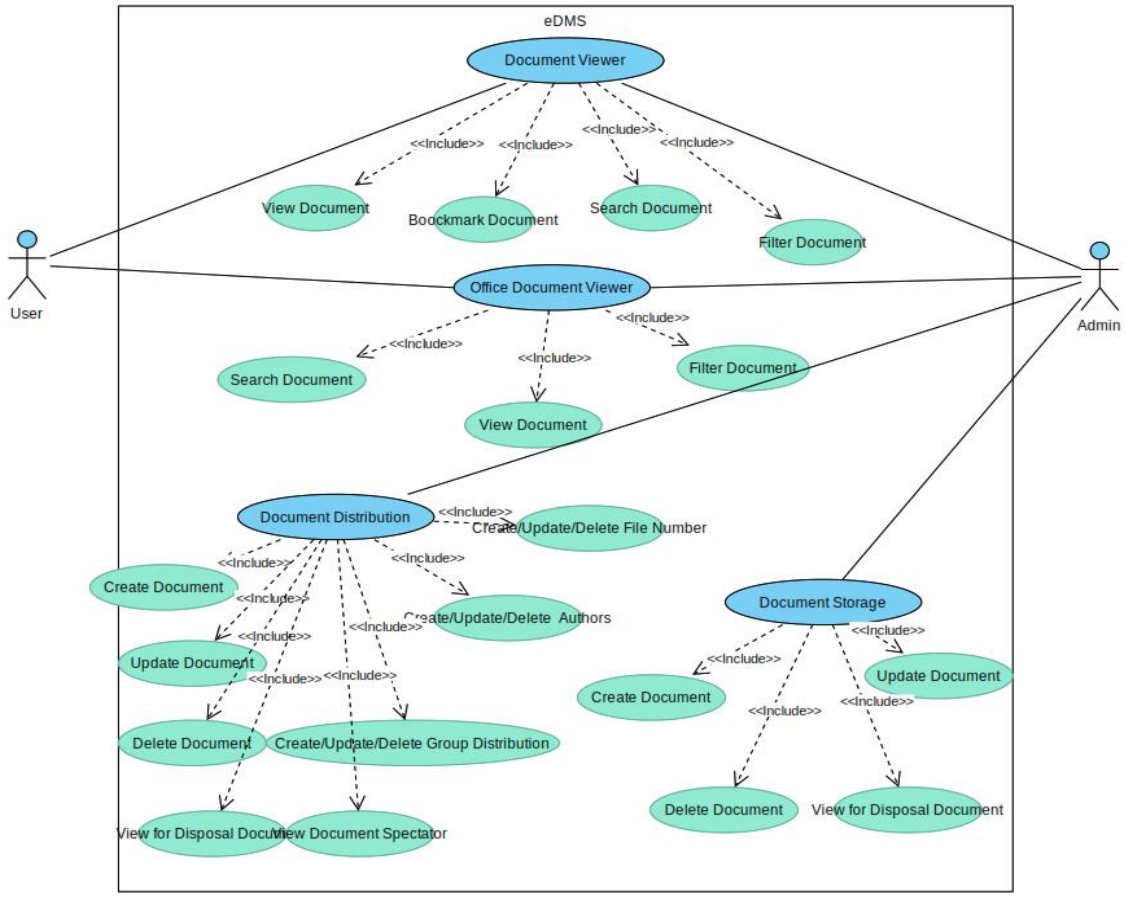


Figure 4. Use-case diagram of the EDMS

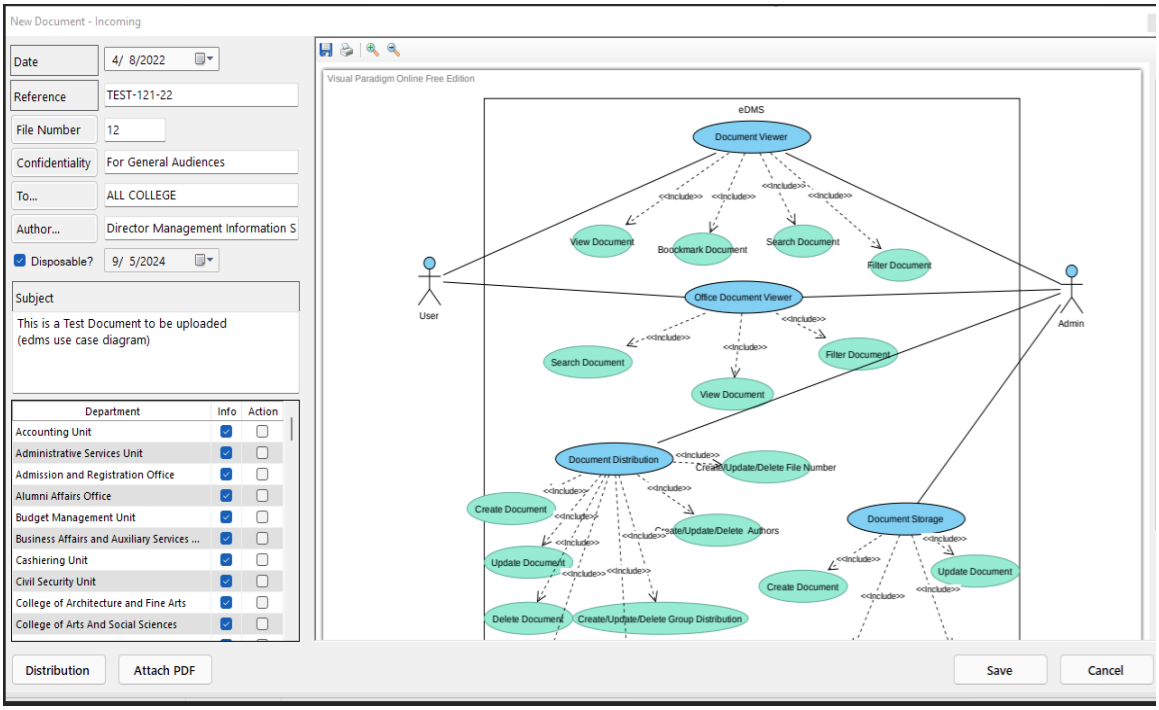


Figure 5. Document distribution

Figure 6 displays the list of employees who have accessed the document. In a local area network (LAN)-based organization with a well-established domain, the viewer information includes crucial details such as the employee ID, employee name, date and time of last view, workstation name, MAC address, and IP address. This feature is critical in ensuring the proper dissemination and receipt of the document, as it provides proof of who has accessed the document and when.

The information captured in the viewer list provides a clear and comprehensive track of who has accessed the document and when. This ensures the security and confidentiality of the document as it is only available to authorized personnel. Additionally, the information about the workstation and network details, such as the MAC address and IP address, further validates the authenticity of the document's distribution and access. By having this feature, the system helps in maintaining the integrity of the document and its distribution process within the organization.

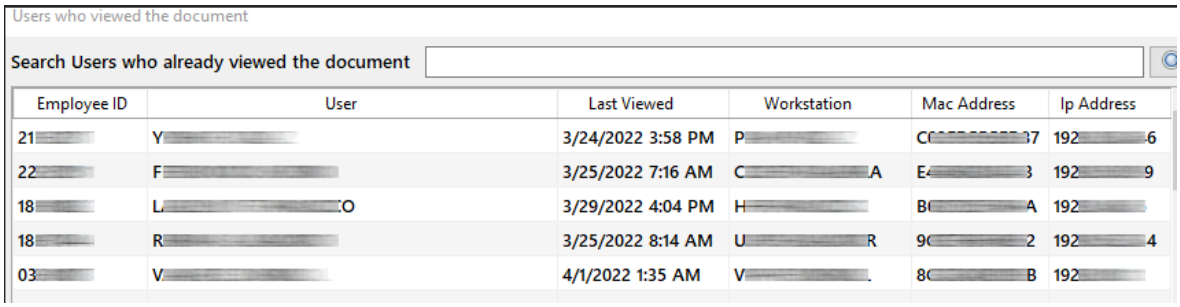


Figure 6. Viewers of documents

3.3. Documents for disposal

The EDMS is designed to efficiently identify and filter documents that have reached their designated disposal date. The retention period, which is determined by established policies and regulations, is recorded when the document is stored in the EDMS. Algorithm 1, as shown is used to filter the database for documents that are ready for disposal. The database query is used to filter documents for disposal. The query retrieves the document ID, date, active until date, reference, and subject of the documents. The filter criteria is that the active until date must not be null, must be less than the current date, and the is rau for storage only and is deleted fields must be set to 0.

Algorithm 1. Database query for filter documents for disposal

```
CREATE PROCEDURE [dbo].[GetDocumentsForDisposal_Distributed_RPT]
AS
SELECT [DocumentID]
          ,CAST(isNull(null,0) as bit)[✓    ]
      ,CONVERT(VARCHAR(12),[DATE],101)[DATE]
          ,CONVERT(VARCHAR(12),ActiveUntil,101)[Active Until]
          ,[Reference]
      ,[Subject]
          --,dbo.fn_dms_Department(NameOfOfficeID)[Name of Office]
          --,dbo.fn_dms_Department(DocPhysicalLocationID)[Doc's Physical Location]
  FROM [Documents]
  WHERE ActiveUntil IS NOT NULL
  AND
  ActiveUntil < GETDATE()
  AND isRauForStorageOnly = 0
  AND isDeleted = 0
```

The EDMS can filter stored documents that are due for disposal based on their lapsed retention period as per existing policies and laws. This retention period is identified and recorded during the storage of the electronic document. The disposal process is initiated by executing a filter query which generates a list of documents due for disposal, displayed in Figure 7. The system administrator can then select the desired documents or select all to be permanently deleted from the database. There is also an option to print a list of the selected documents for recording purposes.

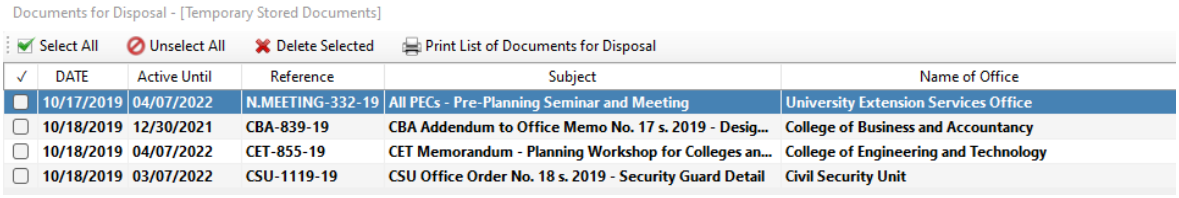


Figure 7. Documents for disposal

3.4. Distributed document viewer

The distributed document viewer module in the EDMS, as shown in Figure 8, provides a list of all uploaded documents for viewing by recipients. Access to the documents depends on both the user's confidentiality clearance and the distribution of the records office. Only users with a higher confidentiality clearance can view documents marked with high confidentiality levels. Only users assigned to the specific office that was tagged in the distribution of the records office can view the document in the list. To view a document, the user can double-click or right-click the selected document. The distributed document viewer also offers features such as bookmarking favorite documents, sorting documents in ascending or descending order, searching, and filtering documents.

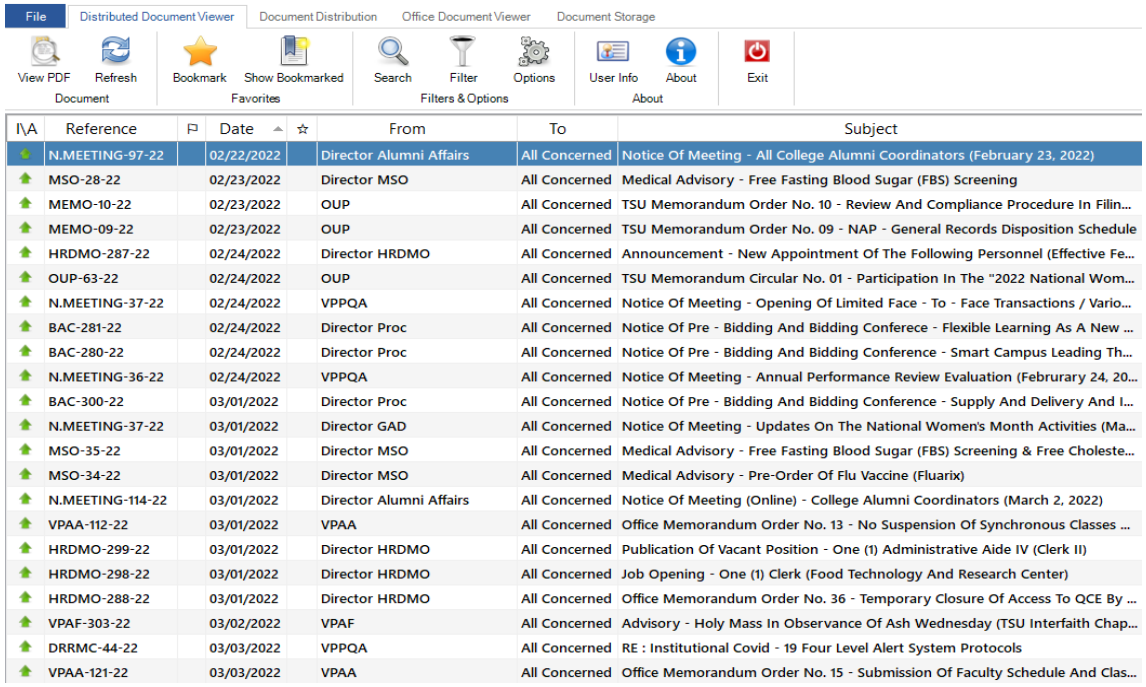


Figure 8. Distributed document viewer

3.5. Indexing, searching and filtering

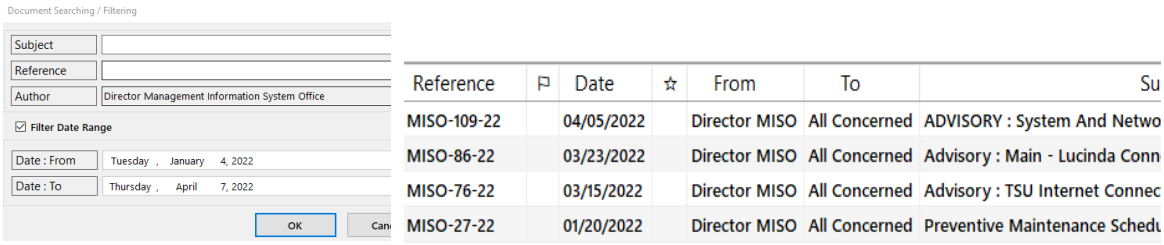
The indexing of reference, author, and subject fields enables more efficient searching and retrieval of documents within the electronic document management system. By using these fields as parameters, the system can provide improved smart search functionality and keyword extraction capabilities [24]-[26]. The Algorithm 2 shows how the EDMS performs document retrieval based on the reference, author, and subject fields. The SELECT statement retrieves the desired columns, including DocumentID, access status, reference, viewing status, date, bookmark status, sender, recipient, subject, and viewing status in Boolean form. The DocumentID column is filtered based on the user's department and employee ID, as well as the specified search parameters for reference, author, and subject. Confidentiality level is also considered, with only documents accessible to the user based on their clearance level being retrieved. Finally, the results are ordered by date and DocumentID, with the most recent appearing first.

Algorithm 2. Database query to search and filter document

```
        BEGIN
                SELECT TOP (@TopColumnCount)
                        [DocumentID]
                        ,dbo.fn_IOType(DocumentID,@DeptID,@empID)[I\A]
                        ,[Reference]
                        ,[dbo].[fn_isViewed](DocumentID,@empID)[⚐]
                        ,CONVERT(VARCHAR(12),[Date],101)[Date]
                        ,dbo.fn_isBookMarked(DocumentID,@empID)[☆]
                        ,dbo.fn_SenderReceiver(AuthorID)[From]
                        ,dbo.fn_SenderReceiver(ToID)[To]

                        ,[Subject]
                        --,dbo.fn_FileNumber(FileNumberID)[File]
                        --,ActionCompleted[Act]
                        --,IOType[Type]
                        ,[dbo].[fn_isViewed_Boolean](DocumentID,@empID)[Viewed]
                From [Documents] Where DocumentID in
                (Select DocumentID FROM DocumentDistribution Where DepartmentID IN
                (SELECT DepartmentID FROM hr_solutions.dbo.Pay_Employees WHERE EmployeeID =
@empID
                UNION ALL
                SELECT DepartmentID FROM tsu_dms_dar.dbo.UserAdditionalDepartmentAccess WHERE
UserID = @empID))
                AND
                [Subject] LIKE '%'+@SearchSubject+'%'
                AND
                Reference LIKE '%'+@SearchReference+'%'
                AND
                dbo.fn SenderReciever2(AuthorID) LIKE '%'+@SearchAuthor+'%'
                AND ConfidentialityLevelID < = dbo.fn_ConfidentialityLevel(@empID)
                AND isDeleted = 0
                AND isRauForStorageOnly = 0
                ORDER BY CAST([Date] AS DATETIME) DESC, DocumentID DESC
        END
```

The capability to search and filter documents is a crucial aspect of an EDMS as it speeds up document retrieval. Figure 9 shows the searching and filtering feature of the EDMS. To search for a specific document, users can select the search option and input any relevant keyword from the database. Figure 9(a) demonstrates that documents can be filtered based on fields such as subject, reference, author, and date range. These fields have been designated as indices, which allows the EDMS to efficiently search for documents. When the filtering and search query is run, the system produces a list of relevant documents based on the parameters entered. The output of this query is shown in Figure 9(b) as an example.



(a) (b)

Figure 9. Search and filter feature of the system (a) fields for filtering and (b) result of the search query

3.6. Users evaluation

The developed electronic document management system was thoroughly evaluated by 20 users to assess its ability to meet their requirements in terms of functionality, performance efficiency, usability, and reliability. The results of the user evaluation are displayed in Table 2. The users rated the system as outstanding across all four criteria and found it to be an efficient and effective tool for managing and distributing critical organization-wide documents. By using the system, the users reported saving time, effort, and resources in retrieving, searching for, and filtering records. The evaluation results indicate that the system effectively meets the needs and expectations of its users.

Table 2. Evaluation of users

Criteria	Mean	Verbal interpretation
Functional suitability	4.80	Outstanding
Performance efficiency	4.75	Outstanding
Usability	4.95	Outstanding
Reliability	4.80	Outstanding
Total mean	4.83	Outstanding

4. CONCLUSION

This study presented the design, development, and implementation of an electronic document management system for a LAN-based organization. The system aimed to enhance office workflow by capturing, indexing, storing, and retrieving documents electronically, ultimately reducing paper waste. The EDMS also provided an efficient and secure way of sharing information with different stakeholders while adhering to standardized compliance rules. Based on the successful implementation and positive evaluation results, the EDMS can serve as a model for organizations with established local area networks looking to implement their own document management system.

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