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## A Case-Based Reasoning Recommender Model for Confusable Diseases

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**ABSTRACT:** Medical Diagnosis can be defined as the process of finding out which disease or condition explains a person's symptoms and signs. The process of diagnosing confusable diseases is usually complex especially when there is no automated system to back it up. Medical Diagnostic system is very crucial in generating accurate and rapid diagnosis of disease. Particularly, in today's era, there are several diseases whose symptoms are quite similar in initial stage. But at the same time, initial level diagnosis is also required to be accurate. In other words, there is need for automating diagnosis systems in order to have accurate results. An automated Case-based Reasoning Recommender System for confusable diseases is an intelligent system that supports automatic decision-making activities. In this study, we present the analysis of the existing systems and further present a Case-based Reasoning Recommender Model for improving the diagnosis of confusable diseases.

**KEYWORDS:** Case-Based Reasoning, Confusable Diseases, Diagnosis

### I. INTRODUCTION

Medical Diagnosis can be defined as the process of finding out which disease or condition explains a person's symptoms and signs. The process of diagnosing confusable diseases is usually complex especially when there is no automated system to back it up. Medical Diagnostic system is very crucial in generating accurate and rapid diagnosis of disease. Particularly, in today's era, there are several diseases whose symptoms are quite similar in initial stage. But at the same time, initial level diagnosis is also required to be accurate. In other words, there is need for automating diagnosis systems in order to have accurate results. An automated Case-based Recommender System for confusable diseases is an intelligent system that supports automatic decision-making activities.

The main focus of this study is to develop an automated Case-based Recommender System for confusable diseases in order to provide automatic decision making for given data. Secondly, Government should also promote research on the automation of diagnosis systems in the health sector. Decision-making in the medical field remains a difficult task for medical doctors as a result of confusable diseases. Indeed, there is uncertainty when a medical doctor encounters confusability of symptomatic presentation of diseases due to the fact that they share common symptoms and as such becomes difficult for the medical doctor to correctly diagnose them.

A major landmark of medical practitioners is the ability to carry out successful diagnoses and prevent diseases. Hence, it is very essential to implement a system that reduces cases of mis-diagnosis which could arise from confusable diseases. According to Asogbon [1], "the administration of efficient healthcare services has been a major challenge in developing countries due to inadequate healthcare delivery personnel and the inappropriate diagnostic techniques often adopted". However, in rural settings of Africa, clinical diagnosis (based on symptoms) remains the only option for diseases diagnosis and this makes accurate diagnosis unlikely. Several factors including lack of good water supply, high prevalence of asymptomatic infections in rural communities, improper waste management system, and insufficient access to trained healthcare providers, inadequate healthcare facilities, and widespread practice of self-treatment for

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clinical diseases. Advancement of these technologies helps individuals and organizations in using this information to support their decision-making activities.

## II. RELATED WORK

Fabiana et al [2] looked at Case-based Recommender Systems: A Unifying View. The work developed a unifying framework to model case-based reasoning recommender systems (CBR-RSs). CBR-RSs have complex architectures and specializes the CBR problem solving methodology in a number of ways. The goal of the developed framework is to illustrate both the common features of the various CBR-RSs as well as the points where these systems take different solutions. The proposed framework was derived by the analysis of some systems and techniques comprising nine different recommendation functionalities. The ultimate goal of the framework is to ease the evaluation and the comparison of case-based reasoning recommender systems and to provide a tool to identify open areas for further research.

Barry [3] proposed a system that allows case-based recommenders to make judgments about product similarities in order to improve the quality of their recommendations and as a result this type of approach has proven to be very successful in many e-commerce settings, especially when the needs and preferences of users are ill-defined, as they often are.

Daniela et al [4] researched on Case-based Recommender Systems inspired by social insects. According to them, "Case-based recommender systems can learn about user preferences over time and automatically suggest products that fit these preferences. In their work they presented a system called CASIS. In CASIS they combined case-based reasoning approach with a metaphor from colonies of social insects namely the honey bee dance. In nature, this metaphor is used to indicate the best nectar source among honey bees. Similarly, they used it to retrieve the most similar case to the user's query. Their results show that this combination is effective when used in the retrieval step of the recommendation cycle: the most similar case is found by the "bees".

Cataldo et al [5] looked at case-based recommender systems for personalized finance advisory. They further illustrated that Wealth Management is a business model operated by banks and brokers that offers a broad range of investment services to individual clients to help them reach their investment objectives. Wealth management services include investment advisory, subscription of mandates, sales of financial products, collection of investment orders by clients. Due to the complexity of the tasks, which largely require a deep knowledge of the financial domain, a trend in the area is the exploitation of recommendation technologies to support financial advisors and to improve the effectiveness of the process.

Mehmet et al [6] discussed a web-based conversational case-based recommender system for ontology aided metadata discovery. They further illustrated that locating resources of interest in a large resource intensive environment is a challenging problem. In their paper they presented the research on addressing this problem through the development of a recommender system to aid in metadata discovery. Their recommender approach uses Conversational Case Based Reasoning (CCBR), with semantic web markup languages providing a standard form for case representation. We present our initial efforts in designing and developing ontology for an Earthquake Simulation Grid, to use these to guide case retrieval, discuss how these are exploited in a prototype application, and identify future steps for this approach.

Anna et al [7] looked at a case-based recommendation approach for market basket data. According to them, "the most widely used recommendation techniques tend to recommend similar items to those liked by a user in the past or items that similar users liked based on the hypothesis that users have a stable behavior over time and that similar users share similar tastes. However, these methodologies show limited performance when new users or less popular items appear often called a cold start while others can lead to overspecialization of the recommended items. In addition, because they tend to ignore the underlying structure of user preferences and don't evaluate the hidden concepts under which items are selected, their accuracy decreases when trading items with unequal probability distributions.

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Paolo et al [8] researched on Case-based recommender systems have been successfully applied to tourism web sites for suggesting to travelers’ products they might like such as hotels or events. Since they exploit previous experiences by other travelers (cases), their case-based needs to be bootstrapped at deploy time by inserting initial experiences. In their work, they addressed the open problem and propose a methodology for bootstrapping case-based recommender systems by exploiting the tracking features of Web Analytics tools.

Jieli et al [9] looked at personalized recommendation systems: An application case-based reasoning. The work explores the application of case-based reasoning (CBR) to personal recommender system. The proposed approach incorporates users’ characteristics as well as the object’s attributes. Important aspects of the approach are similarity determination and case retrieval techniques are described. It is proposed that such a focus can lead to more effective personal recommendation system. Their paper also focused on the case similarity determining tactics and case retrieval tactics.

Amer [10], looked at the architecture of Collaborative Filtering (CF) recommender system recommending preventive / corrective procedures in the occupational health and safety management system in an enterprise. His work suggested that an effective architecture of a case-based model must be simulated before its application.

### III. CASE-BASED REASONING RECOMMENDER SYSTEM: A UNIFYING VIEW

Recommender systems are being used in e-commerce web sites to help customers in selecting products more suitable to their needs. The growth of Internet and the business to consumer e- Commerce has brought the need for such a new technology. In the past years, a number of research projects have focused on recommender systems. These systems learn about user preferences over time and automatically suggest products that fit the learned user model. Case Based Reasoning (CBR) is one of the most successful machine learning methodologies that exploit a knowledge-rich representation of the application domain. Basically, CBR is a problem-solving methodology that addresses a new problem by first retrieving a past, already solved similar case, and then reusing that case for solving the current problem [2]

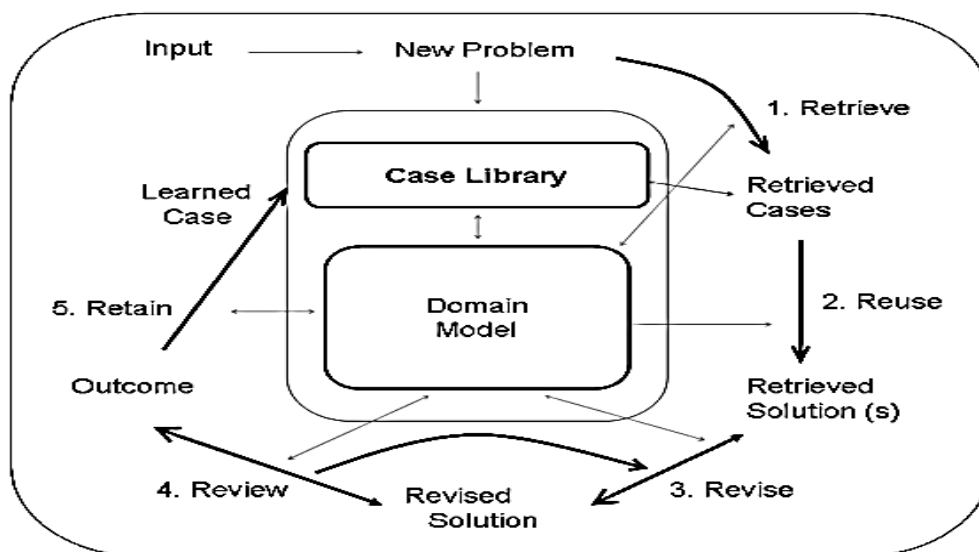


Figure 1.0: Case-Based Reasoning Problem Solving Cycle  
(Source: [2])

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## 3.2 Confusable Diseases

These are diseases that share common symptoms and as such become difficult for the medical doctor to correctly diagnose them. Also, when several diseases contain overlapping symptoms which poses a challenge to a physician to correctly diagnose, are regarded as confusable diseases. Some examples of these diseases are:

- i) Vasculitis
- ii) Tuberculosis
- iii) Malignancies

## IV. RESULTS AND DISCUSSION

### 4.1 Methodology

The Methodology for the Proposed System Design is Structured System Analysis and Design Methodology (SSADM). Structured Systems Analysis and Design Methodology is a systems approach to the analysis and design of information systems. SSADM was produced for the UK government office concerned with the use of technology in government, from 1980 onwards. System design methods are a discipline within the software development industry which seeks to provide a framework for activity and the capture, storage, transformation and dissemination of information so as to enable the economic development of computer systems that are fit for purpose.

The Methodology application to the proposed system involved the following stages:

- **Stage One:**  
**Analyzing Existing ways deployed to tackle the issue:**  
There was in-depth analysis on current performance of the Existing System in Recommending reliable information to users.
- **Stage Two:**  
**Existing System Performance and Identification of Anomalies:**  
This phase involved studying result performance of the Existing System in order to spot any anomaly that should be corrected.
- **Stage Three: Review of any spotted anomaly from the Existing System:** This phase involved the deployment of the proposed system algorithm to any spotted anomaly from the Existing System Performance.
- **Stage Four:**  
**Comparison of the Existing and Proposed Systems Performance Result:** This phase involves comparing results of the Proposed and Existing Systems Performance.
- **Stage Five:**  
This phase involves the adoption of the most efficient result that tackles the mentioned issue due to the outcome of the comparison between the Existing and Proposed Systems.

### 4.2 Analysis of the Existing System

The Present Recommender System applied by most organizations is a Collaborative Filtering (CF) Recommender System as developed by [10]. Many existing recommender systems rely on the Collaborative Filtering (CF) and have been extensively used in E-commerce, Medicine, Engineering, etc. They have proven to be very effective with powerful techniques (see figure 2.0). The Existing System presents an overview of the field of recommender systems with current generation of recommendation methods and examines comprehensively CF systems with its algorithms. Collaborative Filter recommender systems try to suggest products that are similar to the ones that the user liked in the past. Furthermore, Collaborative Filter recommenders treat suggestions as a user-specific category problem and learn a classifier for preferences depending on traits. Techniques applying a Collaborative Filter-based recommendation

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strategy evaluate a set of documents and/or details of products previously ranked by a user and develop a model or user profile of user passions depending on the features of the things rated by that user.

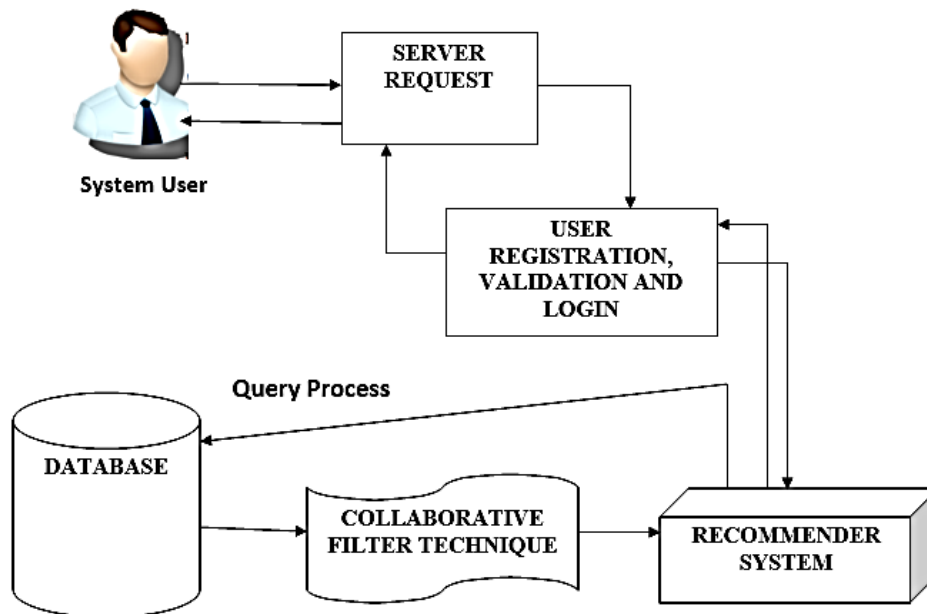


Figure 2.0: Existing System Architecture of a Collaborative Filter Recommender System  
(Source:[10])

### 4.3 Description of the Existing System Components

The following components of the Existing System are:

- **System User:**  
The system user is the individual who launches the system in search of recommended data.
- **Server Request:**  
This is the web platform that is powered by a web server and also enables the user to access the backend of system.
- **User Registration, Validation and Login:**  
This component enables the user to register with important details in order to be allocated a unique username and password for login.
- **Recommender System:**  
This is a Software tool and technique that provide suggestions for items to be of use to a user.
- **Collaborative Filter Technique:**  
This component interfaces with the database by trying to suggest products that are similar to the ones the user liked in the past.

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## 4.4 Disadvantages of the Existing System

The following are the disadvantages of the Existing System:

- The existing system is not intelligent due to lack of an unsupervised learning technique
- it does not implement a Case-Based Reasoning Concept before the recommendation of information to its users
- The Existing Data also needs a lot of Big Data in order to make efficient and reliable recommendations to its users.

## 4.5 Analysis of the Proposed System

The Proposed System of this study is a Case-Based Reasoning (CBR) Recommender System for Confusable Diseases. Case-Based Reasoning (CBR) is a methodology in the field of AI for capturing and reusing experiences (see figure 3.0). The CBR methodology uses these experiences to yield solutions to a large range of problems where uncertainty is involved. Implied by the name, CBR can be broken down into two main concepts: cases and reasoning. A case is an experience of a solved problem and consists of two parts: a problem description and its solution. Reasoning refers to the approach of finding solutions to problems by evaluating different experiences (i.e. cases). Reasoning in CBR differs from other kinds of reasoning because it does not lead from true assumptions to true conclusions. This means that for two cases with similar problem descriptions, the solution to one might not be the solution to the other. The recorded experience in the first instance may not be exactly similar to the other case.

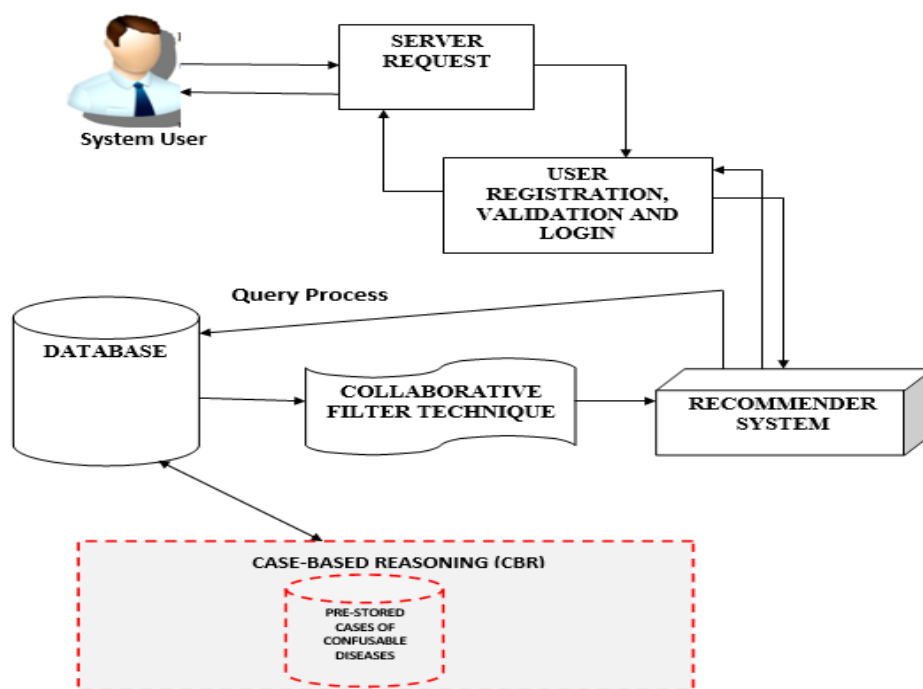


Figure 3.0: Proposed System Architecture of a Case-based Reasoning Recommender System for diagnosing confusable diseases

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When the system receives a new problem, it first performs step 1 in the CBR-cycle (retrieve) by selecting the most similar case. This step includes using similarity measures to determine the similarity between each case and the new problem. Next, the system adapts the solution of the case to the new problem (step 2, reuse). The proposed solution to the new problem is then tested by the system, and if found necessary repaired (step 3, revise). Finally, the adapted solution is stored as a new case in the system's collection of cases, called the case-base (step 4, retain). In this type of recommender system, Knowledge-Based (KB) systems recommend items based on particular domain knowledge about how certain item features fulfill users' needs and preferences and, eventually, how the item is useful for the user. Remarkable knowledge-based recommender systems.

## 4.6 Description of the Proposed System Components

The following components of the proposed system are:

- **System User:**  
The system user is the individual who launches the system in search of recommended data.
- **Server Request:**  
This is the web platform that is powered by a web server and also enables the user to access the backend of system.
- **User Registration, Validation and Login:**  
This component enables the user to register with important details in order to be allocated a unique username and password for login.
- **Recommender System:**  
This is a Software tool and technique that provide suggestions for items to be of use to a user.
- **Collaborative Filter Technique:**  
This component interfaces with the database by trying to suggest products that are similar to the ones the user liked in the past.
- **Database:**  
This is an organized collection of related files that are usually in digital form.
- **Case-Based Reasoning:**  
This component enables the system to recommend vital information to the user based on the referencing of similar cases that relates to the user's request.

## 4.7 Advantages of the Proposed System

The following are advantages of the proposed system:

- It can serve as a teaching tool in a variety of medical fields using human cases to impart relevance and aid in connecting theory to practice. The impact of Case-based Reasoning can reach from simple knowledge gains to changing patient care outcomes.
- The proposed system goes beyond simple identification of correct answers and is more aligned with either evidence of critical thinking or changes in behavior and generalizability of learning to new cases.
- The proposed system adopts an unsupervised learning technique.

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## V. CONCLUSION

In this study, we have presented a Case-based Reasoning Recommender System for Confusable Diseases. Case-based reasoning (CBR) is a problem-solving methodology that tries to solve new problems by re-using specific past experiences stored in example cases. A case models a past experience, storing both the problem description and the solution applied in that context. All the cases are stored in the case base. When the system is presented with a new problem to solve, it searches for the most similar case(s) in the case base and reuses an adapted version of the retrieved solution to solve the new problem.

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