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Courtroom Decision Support System Using Case Based Reasoning

Teo Kuan Wah[a], Manoranjitham a/p Muniandy[b*]

[a,b]Faculty of Information & Communication Technology
University Tunku Abdul Rahman (UTAR)
Jalan Universiti, Bandar Barat, Kampar, 31900, Perak, Malaysia

Abstract

The legal practices in our country have not seen any major changes in terms of technology advancement for decades. While decision support system finding inroads in many other specialized areas, there has been no work done to bring decision support system into legal environment. It is extremely a lengthy waiting period of time to bring a case to court, let alone the whole process of trial until the judgment day. To address this problem, it is suggested to convert our current legal practice into an intelligent based decision support system. A study was conducted by developing a prototype applying a decision support technique to serve as a "virtual courtroom" to plaintiff and defendant in solving their legal cases without the involvement of actual trial. To ensure the system produces fair solutions, case based reasoning was identified as the most suitable technique. This paper proposes the application of case based reasoning in solving legal cases due to the characteristics of the technique which resembles human cognition in solving problems..

Keywords: Case based reasoning, Decision support system, Court room system, Intelligent legal system

1. Introduction

Decision support system has become increasingly in use in various areas such as medical, engineering, technology, management, sales and marketing. This paper presents research on development of an intelligent decision support system using case based reasoning which will be used to

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*Corresponding author.
E-mail address: manoranm2utar.edu.my

efficiently decrease the number of cases brought for hearing in courts. Courtroom Decision Support System (CDSS) is a new concept since there is no similar systems are known to exist. All existing legal softwares are merely a management system to manage documents, to calculate bills, to store documents, to prepare legal documents for clients and etc. The suggested Courtroom Decision Support System (CDSS) is developed to facilitate police officers in police stations throughout the nation. By using CDSS, police officers able to provide a "virtual courtroom" to solve simple cases such as accident cases. This system encourages out of court settlement thus reducing the number of pending cases to be solved in a country.

Why CDSS is first of all needed in this world? Take a typical car accident case as an example. Two vehicle involved in a car accident takes years to reach settlement due to the lengthy process of investigation needed when the case reaches for hearing in a court. As a result, both defendant and plaintiff waste their energy and money throughout the hearing. Imagine having an intelligent system that is able to greatly reduce this situation? We developed an online based CDSS using case based reasoning. Why case based reasoning was chosen? It is a straightforward technique that applies past experiences in solving new cases (Slade, 1991).

Many researchers have highlighted the ability of our memory in remembering and recovering similar incidents based on some new events. Farhi Marir and Ian Watson (1994), has also mentioned in their paper titled "Case-based reasoning: a categorized bibliography" that case based reasoning receives increasing attention from expert system developers as well as from novices due to the resemblance of the cognitive model to human reasoning. Researchers like Petra Perner have even used Case Based Reasoning for image segmentation and image processing in computer vision environment. Another example will be the groupings of user behaviour through CBR and clustering technique (Cocea & Magoulas, 2012). The application of CBR technique in various fields has encouraged the authors to develop a decision support system incorporating the very same technique as the base of the system.

2. Literature Review

Many studies have been reported on the application of case based reasoning as a decision support system in various fields over the years; however none was in legal system. The only well known system being used in legal environment is WinJuris. However, WinJuris is merely a management system rather than a decision support system. The actual task one can accomplished using WinJuris is to maintain basic information on defendants, witnesses, offences, fines, costs payments, minutes, court documents, accounting module and etc (PTS Solution, 2011). Therefore the authors of these paper has decided to plug in the idea of applying case based reasoning into courtroom decision support system and to produce a prototype to be tested with selected police station, plaintiffs and defendants at the end of this project.

Case-based reasoning is a problem solving paradigm that in many respects is fundamentally different from other major AI approaches. Instead of relying solely on general knowledge of a problem domain, or making associations along generalized relationships between problem descriptors and conclusions, CBR is able to utilize the specific knowledge of previously experienced, concrete problem situations (cases)" was found quoted in a published work of Aamodt (1994). Referring to Figure 1. Case Based Reasoning Diagram (Pal & Shiu, 2004) the processes involved in solving a case are divided into four (de Mantaras & Plaza, 1997) . These processes are better known as the four "R's."
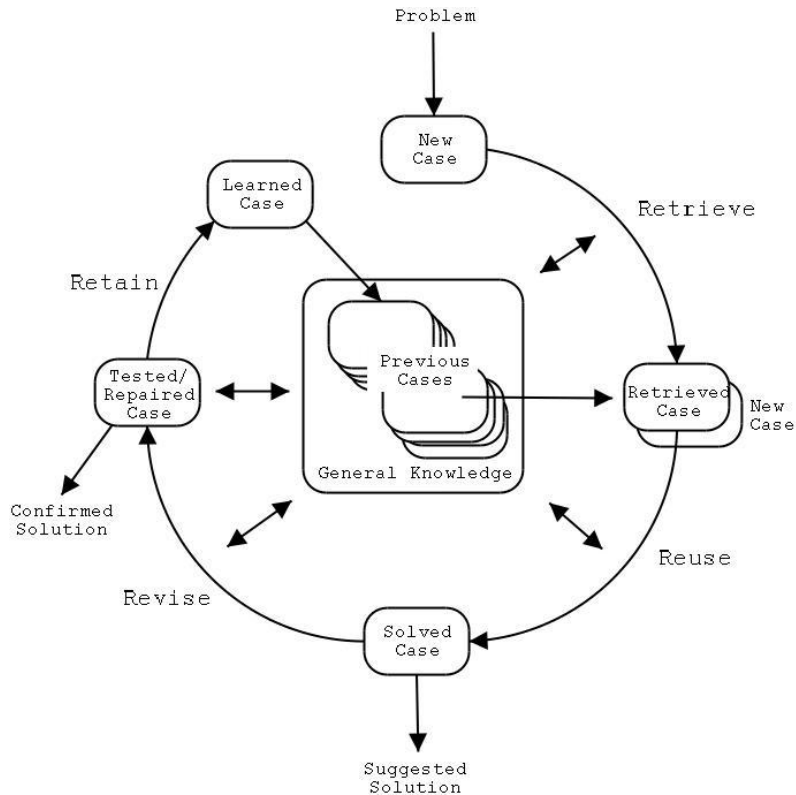
Fig. 1. Case Based Reasoning Diagram

1.   Retrieve:

Upon facing a new problem, the process "Retrieve" refers to the action of retrieving cases of similar or closest matching problem from the previously stored repository. As an example, in the Case below:

1) accident case involves a car and a lorry driven by a drunken driver with car driver experiencing minor injuries. Now, (case 2) similar case has happened sometime ago but involving two cars whereby one of the drivers is drunkard causing another driver with minor injuries. Though the vehicles in the both cases are not the same, the case has some similarities in terms of drunken driver and minor injuries.

2.   Reuse:

Reuse refers to the process of reusing the solutions by suggesting or by incorporating solutions of the retrieved cases. Again, looking at the above given example, in case 2, the drunken driver was jailed and was ordered to pay the injured driver a lump sum of RM 10,000.00. This solution can be suggested as one of the possible solutions for case 1. There may be more suggested solutions, depending on the number of similar cases retrieved.

3.   Revise:

The third 'R' in the phase refers to "Revise" or revision. In here, one can choose to adopt the suggested solutions or revise the solutions in order to solve the current problem. Discussing the same case, the retrieved solution in "reuse" phase can be opting for case 1 since in this situation, both cases

matches closely with one another. In worse case situation, at least the suggested solution can be used partially with some modifications or revision which suits well for case 1.

4.   Retain:

The last phase of the cycle will be "retain" phase. Retain phase refers to the action of retaining solution which solved the problem. The solution that solved case 1 will be retaining as "learned case" into the repository for future use.

Another related work done in different field by Souad Guessoum and his coresearchers was an application of Case based reasoning as their decision making technique in diagnosing chronic obstructive pulmonary disease. Basically, the authors gather the experience and knowledge of other doctors and professionals and use them as guidance in diagnosing the disease. This system is expected to support some young clinicians in the diagnosis of the disease. These authors have also addressed the problems of missing data in the medical domain. Proposing some additional approaches to overcome this missing data issue, these researchers have agreed strongly on the advantage of using case based reasoning as a good decision making technique.

The application of case-based reasoning as a decision making technique extended with a recent research by Ying Lu, Qiming Li and Wenjuan Xiao in their study titled "Case Based Reasoning for automated safety risk on subway operation: Case representation and retrieval". Their paper proposes the use of case based reasoning which combines case representation and retrieval to analyze safety risk. The innovation of the proposed method lies in the structure of the semantic networks which contain sub- concepts to describe all the possible precursors from workers, physical system and environment. Their proposed idea proved some efficiency in risk analysis thus opening the door for the application of case based to many real world settings.

Case based reasoning is the most suitable technique to be used in solving accident cases. It was agreed and suggested by Karolina Eliasson and Farhi Marir and Ian Watson in their research that case based reasoning resembles human reasoning the most. By applying this algorithm, we'll be able to solve a real time case much faster without hearing the case in the court and without been evaluated by a judge. Now, the concern might be, if justice will be served when a machine takes over the decision making process? In order to eliminate this doubt, we have conducted various testing to ensure all parties including the defendant, plaintiff and policemen are satisfied with the suggested solutions

3. Methodology and Challenges

An incremental workflow model was chosen as the development method due to the large scope of the project. The developer decided to produce the system on incremental basis starting off with only vehicle accident cases as the target cases. The initial system was developed to solve only vehicle accident cases for time being. The developed system was tested in a local police station by police officers and by some selected end users. Their feedback was collected and analyzed to know the preferences of actual user on the system.

4. Testing and Results

Various testing has been conducted to test the acceptance level of the system among the users and clients, to test the functionality of the system and to test the stability of the system. However, only user acceptance testing and client acceptance testing was presented in this paper to support the idea of CourtRoom decision support system. The system was setup to be tested by our users and the users are required to fill in a survey form as the feedback from using the system. Four important questions from the

survey are highlighted in Table 1. Result of User Acceptance Testing to show the acceptance level of the system among the users.

The major challenge faced by the developer was on the difficulty of getting the local police station involvement. The developer had to get multi level approval from the higher authorities twice. First time is for requirement gathering phase from the local police stations and the second time is before getting them to use the developed system to give their feedback.

Table 1. Result of User Acceptance Testing

Survey Questions	Score
Able to retrieve similar cases	80%
Able to retrieve matching solutions	75%
User Friendly	75%
More efficient than current practice	80%

Our users were police officers from local police station as they will be the one who will be using the system in future. Therefore, feedback from the actual users is taken into considerations for future enhancement. Referring to the above, user has rated a score of 80% for the ability of the system to retrieve similar past cases which match the new case. A score of 75% were given for the solution of the retrieved cases, meaning most of the time, the solution of the retrieved cases was able to be reused in a new case as the solution.

The system was rated 75% in terms of user friendliness and 80% was given for the system being more efficient than the current practice of hearing a case in the court. Our users feel that the system able to reduce greatly the number of cases that to be brought to court room for hearing by reusing the solutions of the past cases. That was the feedback from our system users who are police officers from local police station. We have also conducted another testing among the clients. Our clients are plaintiffs and defendants of a case. Once again the system was setup for our client's testing and they had to fill up a survey form as their feedback upon completing the testing.

Table 2. Result of User Acceptance Testing

Survey Questions	Score
Satisfied with the retrieved solutions	75%
System provides variety of solutions	75%
More efficient than current practice	75%

Feedback from the plaintiff and defendant are shown in Table 2. Result of Client Acceptance Testing. The results are also depicted in the form of a chart in Fig. 3. Referring to Fig. 3. Client Acceptance Testing Chart, three questions from the survey were identified and highlighted to show client's acceptance level towards the system.

Clients rated 75% as their satisfaction score on the retrieved solutions. It shows they are more than just satisfied to reuse some of the suggested solutions for their own case. A score of 75% from the clients on the ability of the system to produce variety of solutions also indicates that client had more than one option to accept as their own solution. Both involved parties also able to modify the suggested solutions

to fit their own situation. Lastly, rating of 75% was given by the clients on efficiency of the system against the current practice. The analysis of the testing proves that both users and clients has a positive opinion towards courtroom decision support system and confident that the system able to improve the current manual practice. Obviously, more work need to be done on the system as this is just a prototype which was developed to know the feedback from the public. Detail enhancements are discussed in future enhancement section.

5. Conclusion

Courtroom decision support system using case based reasoning is proven to be efficient and effective. Initial stage of testing shows that the logic of reusing solutions of past cases as the solution of current problem is well accepted by both plaintiffs and defendants. It is also being supported by the police officers as a step to reduce the number of cases brought for hearing. The developed prototype gave an overview of the actual system, its functions and the benefits of having such a system in the society. Obviously, the system needed to be redeveloped with added features and needed to be tested with large scale of users. The complete version of the system needed to be on trial run for some period of time to gain the trust and satisfaction of the public. The researchers of this project strongly believes that refined courtroom decision support system able to greatly reduce the number of cases brought for hearing in court without compromising the justice served.

6. Future Enhancement

As mentioned in the above section, the developed system definitely needed quite a number of enhancements in terms of functionality and security. Currently, the Courtroom decision support system able to record newly lodged cases, able to prepare other case related documents and able to produce reports. In future, there will be more functions in terms of related legal documents preparation, other management issues such as to handle fines, summons, payments and etc. By adding these extra features, the system will be a complete version to be installed and to be used in police stations by the officers. There will not be a need to install different system for management purpose. Apart from that, the security of the system also has to be taken into considerations. Perhaps multi level protections need to be applied in the system to prevent unauthorized access, unwanted attacks and hacks from intruders.

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