

FUZZY EXPERT ADVISORY FOR E-COUNSELLING

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Abstract: Fuzzy Expert is designed to mimic the human decision process of the modular system, maintains the value of based rules and using fuzzy logic to describe uncertainty systems, and utilizes the predominance of using expert systems to denote and control knowledge. This paper presents the use of Fuzzy Expert Advisory for e-Counselling. The advisory model in counseling using a modular system for the psychology testing process for Behavioural Academic Self-Esteem (BASE) is used to test the prototype developed in this study. The system comprises of five modules, namely Student Initiative of BASE Factor 1, Social Attention of Base Factor 2, Success/ Failure of BASE Factor 3, Social Attraction of BASE Factor 4, and Self-Confidence of BASE Factor 5. BASE test consists of sixteen items, categorized into five main BASE factors. The input to the system was first fuzzified and Fuzzy Associative Memory (FAM) table were constructed to handle the fuzzy rules of the five factors of BASE case study. The defuzzification technique known as Centre of Area (COA) is used to estimate the BASE factor and determine the levels of academic self-esteem such as low self-esteem, moderate self-esteem, and high self-esteem. In addition, fuzzy expert provides explanation and also explain how a diagnosis is reached for a particular case. Overall performance of this system was successfully tested and produced the results that were equal to an expert's judgment. The system has been verified by the counselors and, in addition the results also conform to the BASE factor rating scale and sub-scores.

Keywords: Fuzzy Expert, e-Counselling, Hybrid Intelligent Systems, Behavioural Academic Self-Esteem

INTRODUCTION

Fuzzy Expert is designed to mimic the human decision process of the modular system, maintains the value of based rules and using fuzzy logic to describe uncertainty systems, and utilizes the predominance of using expert systems to denote and control knowledge. Such a system is an expert system that uses fuzzy logic instead of Boolean logic, or expert system that operates on a collection of fuzzy variables and rules, according to the principles of fuzzy logic (Kandel, 1991). In other words, a fuzzy expert system is a collection of membership functions and rules that are used to reason about data. Unlike conventional expert systems, which are mainly symbolic reasoning engines, fuzzy expert systems are oriented toward numerical processing (Horstkotte, 2000). The advantages of using the fuzzy expert system over a more conventional expert system is that the rules can be expressed more naturally and usually has significantly fewer rules (Juuso *et al.*, 1999).

Despite its successful application and proven effectiveness, the expert system approach is a difficult and time-consuming to construct knowledge bases. Some practical implementations of such integration can be found in the literature. Holden *et al.* (1999) built the Hand Motion Understanding (HMU) system recognizes static and dynamic hand

signs in Australian Sign Language (Auslan) by dealing with "fine grain" hand motion, such as configuration changes of fingers. The system successfully recognized various 'fine-grain' hand movement. Lam *et al.* (1999) recommends the fuzzy logic expert system in the processing time customized to a production line given the localized ambient state and the condition of the plaster molds. The system also includes a data repository to store and analyze daily process records, an automatic control charting feature, and a training module to expedite the learning curve of new workers.

Another applications are an analysis of the fuzzy expert systems architecture for multispectral image classification using mathematical morphology operators (Marcos, 2004), whose rules are implemented through translation invariant mathematical morphology operators and uses the expert systems for image classification. Hayo *et al.* (1997), Pesticide use options available to farmers differ strongly with respect to the risks they pose to the environment. It uses a fuzzy expert system to calculate an indicator "Ipest" which reflects an expert perception of the potential environmental impact of the application of a pesticide in a field crop.

The findings by Fahmy *et al.*, (1999) indicate that fuzzy expert systems have proved to be very successful in formalizing the practical rules used by the design experts for computer networks design, formalizing the logic of solving computer network design problems, and initially choosing the most suitable solutions for a certain networking requirement. By using fuzzy expert systems to generate the network models/simulations the user is not required to have any kind of background of the simulation package operation. Neither is the user required to be an expert in networks design. In this study, the potential of such integration is applied to *e*-counseling.

The term *counselling* may have different connotations for different people. By counselling it is understand all other interactions between student and institute which are not directly subject related (Rekkedal, 1991). The counselling function thus embraces advice on general problems related student support services (Tait and Sewart, 1983). According to Watt (1998), the term counselling was used to include all the following processes: information provision on training and job opportunities, welfare support; guidance or direction on career and vocational options; advice by offering a possible solution or course of action, and counselling for empowering the individual to make decisions.

E-Counselling is an alternative way of having one to one contact with a Counsellor by exchanging e-mail messages, discussion groups, or access to information sources and interaction through video-conferencing. According to Sampson (2002), the current use of world wide web (www) are counselling via e-mail, bulletin board systems and list servers for specific client concerns, chat for specific topics and career applications.

Psychology is the study of the mind and the behaviour of humans and animals. Some of the areas psychologists study is thinking, learning, cognition, emotions, personality, and abnormal behaviour. In order to study these, psychologists use a variety of methods to observe people including laboratory experiments, field experiments, observational

studies, case studies, and questionnaires (Questia Online Library, 2004). According to Richmond (2004), psychological tests assess and evaluate information that client give to the examiner. This information either in the form of answers to interview questions or as answers on paper or on a computer to specific questions. Ultimately, a test's accuracy depends on how carefully and seriously the user answers the questions being asked. Psychological tests are usually administered and interpreted by a psychologist. A counsellor who has had the appropriate academic courses and supervision may administer occupational tests or achievement and aptitude tests. Some available tests are BASE (Coopersmith and Gilberts, 1981), Behavioural Indicators of Self-Esteem (BIOS), Body Esteem Scale, Coopersmith Self-Esteem Inventory, Personal Evaluation Inventory, Rosenberg Self-Esteem Scale (RSE), Self-Esteem Inventory and etc.

BASE measures children's academic self-esteem by using direct observation of their classroom behaviours. Teachers, parents, or other observers draw on their first-hand experience with a specific child to rate how often the child behaved in particular ways. BASE has been used with children of preschool, elementary, and junior high school, both individually or in groups. The BASE factors structures are divided into five factors: Student Initiative, Social Attention, Success/Failure, Social Attention, Social Attraction, and Self-Confidence and the rating scale consists of 16 items. BASE items are rated to the frequencies of behaviours as Never, Seldom, Sometimes, Usually, and Always. The BASE levels of academic self-esteem for each factor are classified as high self-esteem, moderate self-esteem, and low self-esteem (Coopersmith *et al.*, 1981).

Since the knowledge involved in counselling is imperfect, vague and not completely reliable, then fuzzy logic is integrated with the expert systems is designed to mimic the human decision process of the modular system for the psychology testing process for BASE. In e-counselling, it is important to allow the user to choose their option in flexible manner and human nature in order to estimate the BASE factor score, and as well as to determine their levels of academic self-esteem. Furthermore, the result obtained will provide the information of measuring student's self-esteem at early ages. Therefore this project attempts to explore the possibility of using hybrid intelligent system in order to promote the use of imprecise information in e-counselling.

This paper presents the use of Fuzzy Expert Advisory for e-Counselling. The advisory model in counseling using a modular system for the psychology testing process for Behavioural Academic Self-Esteem (BASE) is used to test the prototype developed in this study.

FUZZY EXPERT ADVISORY SYSTEM

EDotCounsellor was developed by James (1998), a web-based system that provides the online counsellors and online counselling, e-mail counselling, telephone counselling, and chat counselling. This site is a professional online counselling service from accredited counsellors. The use of email, or secure chat, or the telephone to counsel people online around the world and help them find options for change and solutions to problems such as relationship and marriage difficulties, divorce, assertiveness issues, grief, abuse, and

others. For a growing number of people, the convenience and anonymity of email, secure chat, or phone counselling. The site is available at <http://www.edotcounsellor.com>

Wagner *et al.* (1995) concluded that “a more optimal approach may be to explore better ways of integrating minimal interventions with existing face-to-face contacts in such settings as a health care delivery system”. Among the wide range of counselling services that is nowadays offered, web-counselling is evolving as an alternative or supplementary medium of distance counselling for parents of deaf children. The Internet provides the means for effective communication between parents and professionals as well as between parents themselves. Services may vary from e-mail and discussion groups, access to information sources and interaction through video-conferencing. The primary objective is to describe the role of web-counselling and the numerous ways through which it can support, inform and ultimately empower parents of deaf children. In addition, a proposal is made regarding the development of a web-counselling centre, the role of the participants who contribute in the centre operation as well as the level of collaboration among them, and also a number of possible difficulties are taken into consideration, ensuring that web-counselling will become an effective medium of distance counselling with forthcoming benefits for the parents of deaf children (Nikolarazi *et al.*, 2000).

Acquired Intelligence (2004) was involved in developing the following employment counselling applications for Human Resources Development Canada such as the Employment Counsellor's Assistant is a Windows application that helps employment counsellors assist clients by providing recommendations and automatic documentation of a ten-step assessment process. The Expert Counselling System (ECS) helps clients solve their own employment problems at a publicly accessible kiosk. It sites at <http://www.aiinc.ca> lists job tips and local resources that can help clients find suitable work. While the Employment Coach is a version of the ECS developed for use on a desktop computer rather than at a kiosk. It provides useful employment information, tips, and resources and it clarifies issues underlying trouble spots that people may experience while trying to get work. The information is presented in Internet format which is easily changed to update tips, resources, and advice.

Counselling is available for supportive or problem-solving assistance for *academic, vocational, emotional, personal* or *social* concerns. Counsellors help explore these issues and assist students to work toward achieving the goals they have set for themselves. The Centre provides Acadia students the opportunity to discuss, in a private and relaxed atmosphere, *any personal, career, or academic concern* (Acadia, 2004). Other on-line counselling and interactive resources available at <http://www.support4learning.org.uk> provides some useful facilities such as ELIZA is an online counsellor to talk to. An Emotional Intelligence is on-line emotional IQ test and resources, while IQ Tests On-line with links to personality and entrepreneurial tests. On the other hand, some universities such as University of Toronto provide links to learning style theories, assessments, inventories, and tests. The Mind Tools provide major resources site on practical techniques for planning, thinking, stress, psychology and much more, mainly for people in work. Other useful resources available are Counselling organisations and standards,

finding advice and guidance, health information, jobsearch, learning and work, related assessment tools and tests, Internet addiction, human rights, and civil liberties.

In Malaysia, e-counselling has been widely implemented and various services provided to the specific users or nation as a whole. Majlis Kaunseling dan Kerjaya Institusi Pengajian Tinggi Awam (MAKKUMA) has developed by the team of Counselling Centre at Universiti Utara Malaysia (UUM). The web site address is at <http://portal.uum.edu.my/portalbm/ekaunseling/>. This site provides list of resources such as updated news of MAKKUMA, counselling services from counsellors of any IPTA in Malaysia, discussion groups and access to counselling information sources. E-Counselling at Dewan Bandaraya Kuala Lumpur (DBKL) at <http://www.dbkl.gov.my/kaunseling/index.htm> provides online services such as e-mail discussion groups, on-line chat, and others.

Based on the literature review, the advance computing techniques were not being applied much to counselling services. The current practice of the existing system using BASE scale may be scored by hand or by computer based on the rigid crisp values to represent rating number one through five. For each BASE factor, the sub score is provided based on the classifications of Academic Self-Esteem and their respective ranges. The computer scoring service provides a class profile, based on the class norms, which reports percentiles and self-esteem classifications for the total scores and factor scores. When BASE is scored by computer, the error of measurement is reduced and the predictive validity of the scale is improved (Coopersmith *et al.*, 1979).

BASE is used in this study to estimate the factor structures and determine the levels of academic self-esteem of the student. Since BASE requires the ability for estimating the factor structure and also the ability to explain how the conclusion is derived, therefore artificial intelligent techniques that are required to perform BASE must be able to estimate and provide reasoning. Artificial Intelligence (AI) techniques that are suitable for prediction are neural network, fuzzy logic and case based reasoning. On the other hand, expert system and case based reasoning are good at providing explanation to intelligent system. The techniques that provide the estimation and explanation abilities are necessary in this study. For this purpose, fuzzy logic and expert system have been integrated in a web-based environment to demonstrate the use of hybrid system, on BASE factor structure and levels of academic self-esteem.

The system allows the users to slide the input in percentage of BASE items that are rated according to the frequencies of behaviours in uncertainty forms labeled as never, seldom, sometimes, usually, and always rather than the common form of 1, 2, 3, 4, and 5.

The proposed system provides the users particularly teachers, counselors, or parents to measure students' self-esteem at early ages, evaluate factors that affect academic self-esteem, encouraging discussions about self-esteem in parent-teacher conferences, and to establish construct and predictive validity related to common measures of school success. The strategy of incorporating e-counselling capabilities is to provide the schools in the development of information systems that will establish effective linkages with the parents

(users) or other channel partners involved in counselling activities. As a result, the proposed system allows the users especially the teachers, counselors, parents, or other observers to obtain the counselling advisory services through web. Apart from estimating the BASE structure and identifying the academic self-esteem, the system can be used as part of portal development for schools and community as a whole.

Fuzzy Expert Advisory for e-Counselling has been developed using hybrid intelligent system that integrates fuzzy logic and expert system. Due to their capabilities and advantages, this system offers an automated fuzzy expert system in dealing with uncertainty and vague information for BASE. The purpose is to estimate the BASE factor structure and determine the levels of academic self-esteem which obtained from the inputs given by the users. The system facilitates the user by handling the consultation session in order to determine the levels of academic self-esteem. A set of questions will be asked through graphical user interface and assists the user in diagnosing stage based on the given inputs to infer such a conclusion. The consultation and explanation performed by the fuzzy logic and expert system also involved in dealing with the natural and uncertainty data. This study focuses on the system design and development of using hybrid technology and the employment of fuzzy expert system in counselling domain.

Fuzzy Expert Advisory for e-Counselling is a web based application that has been developed using Micromedia Dreamweaver Version 4.0, Microsoft's Active Server Pages (ASP - server-side web scripting), VB Script, and Java Script that caters the inference engine, working memory and graphical user interface (GUI) development. The knowledge base is stored in MS Access as system database. As an expert system, the Advisory system for e-Counselling using Fuzzy Expert can provide explanation to the user regarding its conclusion of classifications either high self-esteem, moderate self-esteem, or low self-esteem based on the factor that has been diagnosed.

Fuzzy Expert system is constructed using 4 major components, which are knowledge base, working memory, inference engine and user interface. Since this system also employs fuzzy logic therefore the inference engine has been subdivided into 3 components: which are fuzzification, fuzzy inference and defuzzification. The system components for Fuzzy Expert Advisory for e-Counseling is as shown in Fig 1.

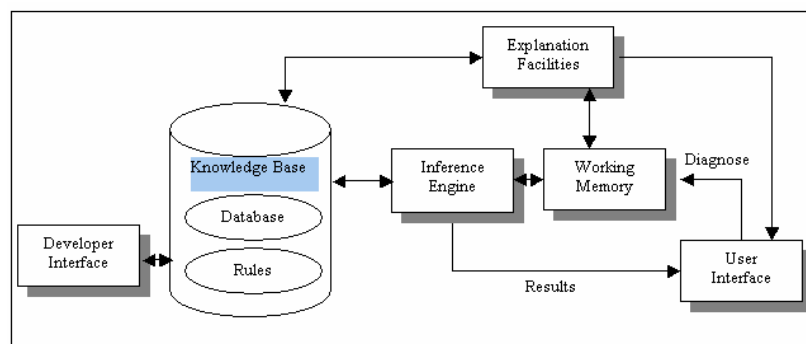


Figure 1: Fuzzy Expert for e-Counselling System Components

RESULTS

Fuzzy Expert Advisory system is a web-based application that runs online and enables the users, particularly the teachers/users to determine the level of academic self-esteem of their students or children. The system is started by asking the user to slide their rating number that they believe is the best estimate of that behavior frequency noted in the classroom. This is done using the user interface for each factor i.e. Factor 1 through Factor 5. By pressing the 'Click' button the corresponding label and Confidence Value will be displayed. The information gathered is then used by the system to infer the conclusion.

Then, fuzzification will be invoked where the real value given by user will be transformed into linguistic values. Each question will have five linguistic labels of *never*, *seldom*, *sometimes*, *usually* and *always*. While, for the output, it has three linguistic labels: *low self-esteem*, *moderate self-esteem* and *high self-esteem*. The input interface to the system and the Confidence Value for the system is as illustrated in Fig. 2.

Fuzzy Expert Advisory for e-Counseling
Main Menu

Behavioral Academic Self-Esteem (BASE)

I. Student Initiative

No	Question	Never	Seldom	Sometimes	Usually	Always
1	This child is willing to undertake new tasks.	0.00	0.00	0.00	1.00	0.00
2	This child is able to make decisions regarding things that affect him or her, e.g., establishing goals, making choices regarding "likes" and "dislikes" or academic interests.	0.00	0.20	0.20	0.00	0.00
3	This child shows self direction and independence in activities.	0.00	0.00	0.00	0.50	0.50
4	This child initiates new ideas relative to classroom activities and projects.	0.00	0.00	1.00	0.00	0.00
5	This child asks questions when she or he does not understand.	0.00	0.00	0.20	0.00	0.00
6	This child adapts easily to changes in procedures.	0.00	0.00	0.00	0.70	0.30

guide to answer question

FAM Reset

Figure 2: Input Interface and Confidence Value

Fuzzy Associative Memory (FAM) was then constructed and exhibited in Figure 3. It applies variable of *Question 7* vertically and *Question 8* horizontally. This FAM table stores the confidence value that will be used for calculating the score for each factor which is produced the output for this system. The fuzzy operator used is AND operator. Therefore the minimum value from the two inputs will be considered as confidence value for fuzzy output variable.

FAM for Behavioral Academic Self-Esteem (BASE)					
FAM for Social Attention (1st Phase) - Output 1					
Question 7	Question 8				
	Never	Seldom	Sometimes	Usually	Always
Never	0.00	0.00	0.00	0.00	0.00
Seldom	Low Self-Esteem	Low Self-Esteem	Low Self-Esteem	Low Self-Esteem	Low Self-Esteem
	0.00	0.20	0.80	0.00	0.00
Sometimes	Low Self-Esteem	Low Self-Esteem	Low Self-Esteem	Low Self-Esteem	Moderate Self-Esteem
	0.00	0.10	0.10	0.00	0.00
Usually	Low Self-Esteem	Low Self-Esteem	Low Self-Esteem	Moderate Self-Esteem	Moderate Self-Esteem
	0.00	0.00	0.00	0.00	0.00
Always	Low Self-Esteem	Low Self-Esteem	Moderate Self-Esteem	Moderate Self-Esteem	Moderate Self-Esteem
	0.00	0.00	0.00	0.00	0.00
	Low Self-Esteem	Moderate Self-Esteem	Moderate Self-Esteem	Moderate Self-Esteem	Moderate Self-Esteem

Social Attention - Output 1		
Output 1	61.17	
Label of Output 1	Low Self-Esteem	Moderate Self-Esteem
Confidence Value	0.58	0.42

FAM for Social Attention			
Question 9	Output 1		
	Low Self-Esteem	Moderate Self-Esteem	High Self-Esteem
Never	0.00	0.00	0.00
Seldom	Low Self-Esteem	Moderate Self-Esteem	High Self-Esteem
	0.10	0.10	0.00
Sometimes	Low Self-Esteem	Moderate Self-Esteem	null
	0.58	0.42	0.00
Usually	Moderate Self-Esteem	Moderate Self-Esteem	null
	0.00	0.00	0.00
Always	Moderate Self-Esteem	Moderate Self-Esteem	null
	0.00	0.00	0.00
	Moderate Self-Esteem	High Self-Esteem	null

Figure 3: Fuzzification Result (Phase 1), Defuzzification Result of Output 1, and Fuzzification Result (Phase 2)

The fuzzy value produces by fuzzy inference will be transformed again into real value. This computation is performed using Centre of Area (COA) the calculated output of Social Attention of BASE is calculated as 88.13.

The results of the Social Attention of BASE and the label is as illustrated in Figure 4. The explanation section provides the corresponding result based on the label. How facility will keep track the questions asked together with the certainty factors.

Fuzzy Expert Advisory for e-Counseling			
Main Menu			
Output			
ii. Social Attention			
Success / Failure	88.13		
Label of Output	Low Self-Esteem	Moderate Self-Esteem	High Self-Esteem
Confidence Value	0.00	1.00	0.00
Result			
Explanation	Moderate Self-Esteem: This child is moderately "fits into" the classroom environment, well exhibit behaviors that facilitate classroom learning, e.g appropriately quiet, avoid undue attention, and cooperate with groups in peers.		
How	This child quiet in class, speaks in turn, and talks appropriately.	0.4	
	This child talks appropriately about his or her school accomplishments.	0.5	
	This child cooperates with other children.	0.5	
Back			

Figure 4: Inference Result

Expert systems use knowledge, facts, and reasoning techniques to solve problems that normally require the abilities of human experts. Expert system imitates the expert's reasoning processes to solve specific problems or narrow problem area efficiently and effectively. In this advisory system for e-counselling, the knowledge base consisting of a database of information necessary for providing expert advice and provide the how conclusion is derived and it is stored in DBExpert file. Fig 4.21 shows the fuzzy expert advisory for e-counselling explanation and how the conclusion is reached together with the CF value. The explanation is obtained based on the defuzzified crisp value as for this case the Social Attention.

Output			
<i>ii. Social Attention</i>			
Social Attention	87.46		
Label of Output	Low Self-Esteem	Moderate Self-Esteem	High Self-Esteem
Confidence Value	0.00	1.00	0.00
Result			
Explanation	This student is moderately "fits into" the classroom environment, exhibit behaviors that facilitate classroom learning, e.g. moderately quiet, avoid undue attention, and cooperate with groups in peers.		
How	This child quiet in class, speaks in turn, and talks appropriately.	0.6	
	This child talks appropriately about his or her school accomplishments.	0.6	
	This child cooperates with other children.	0.6	
<input type="button" value="Next"/>			

Figure 3: Explanation Window of Fuzzy Expert Advisory System

CONCLUSION

This study focuses on the software development using hybrid AI technology and the employment of fuzzy expert system in counselling domain. Fuzzy expert systems model imprecise information, capturing expertise similar to the way it is represented in the expert mind, and thus improve cognitive modelling of the problem. Fuzzy Expert Advisory for e-Counselling offers computerized fuzzy expert system and in line with the developing technology, the web environment is preferred in implementing the artificial intelligence techniques in e-counselling and as well as in psychology domain. This web-based application has been developed to estimate the BASE factor structures and determine the levels of academic self-esteem of the student.

The system helps the user by managing the consultation session in order to obtain the score for a particular factor. A set of questions will be asked through graphical user interface and helps user diagnose their given options to infer such a conclusion. The consultation performed by the expert system also involved fuzzy logic when dealing with the natural and uncertainty data. In addition, fuzzy expert advisory provides explanation and explain how a diagnosis is reached for a particular case. The results showed that the fuzzy expert prototype system presented in this paper provides reliable and accurate results after several test cases have been run. The system performance was successfully tested and produced the results that were equal to an expert's judgment, thus accomplishing the objectives. The system that has been produced, conform to the BASE factor rating scale and sub-scores.

The results obtained provide the information of measuring student's academic self-esteem at early ages. The explanation part in the system may be used to evaluate factors that affect the academic self-esteem, encouraging discussions about self-esteem in parent-teacher conference, and to establish construct and predictive validity related to common measures of school success. Since this study focuses on the software development using hybrid AI technology and the employment of fuzzy expert system in counselling domain, therefore it emphasize on data acquisition, type of questions and mapping of uncertainty into fuzzy values, which consists of labels and confidence values. This involves the determination of membership function graph that requires the knowledge from counselling expert. This mapping process is very crucial in this study since if incorrect membership function graph was chosen, the final value yields from the fuzzy logic system is also incorrect. After several testing has been done, it is realized the fuzzy logic drawbacks are in the aspects of the rules of the fuzzy logic, which apply in this counselling domain have to be determined by the expert experiences. It is difficult to make analysis of determination of a system designed according to the fuzzy logic. That is, it cannot be estimated how the system reacts beforehand. As the membership functions are determined according to the trial and error learning, they take a long time.

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