인터넷상의 Cyber 판매전문가 시스템 : Cyber-SES

이 상 기
한무개발주식회사
서울시 강남구 삼성동 159-8

이 제 규
한국기술원 테크노경영대학원 경영정보공학과
서울시 청량리동 207-43

요 약 문

현재의 인터넷 에서의 전자 상거래는 고객의 요구를 충족하는 고객 원하는 능력에는 한계가 있다. 즉 상품의 사진과 설명을 제대로 해주지 못하고 있는것이다. 이러한 제한을 해결 하기 위하여, 우리가 Cyber 전문가 시스템을 설계, 개발 하려 한다. 이 목적을 충족 시키기 위하여는 우리는 다음과 같은 목표를 성취 하여야 한다.

1) 상품, 고객의 요구, 셀스맨의 전략을 표현 하여야 한다.
2) 대화 형식의 수행 절차를 개발하여, 고객 이 짧은 시간 안에 유연한 거래로서 만족하는 결과를 얻을수 있게 하는 것이다.
3) 인터넷 상에서 아이디아를 수행 할수 있는 수단을 개발 한다.
4) 실제로 사용할수 있는 실용적인 접근과 시스템의 효용성을 보여준다.

적절한 수행 절차 즉, 상품의 효용성과 가격 간을 대화형식으로 거래 하게 함으로서, 제약과 규칙 만족 문제(CRSP)를 채용하여 이러한 목표를 성취 한다. 이 후레임 워크는 JAVA 언어를 사용 하여 인터넷 상에서 운용 할수 있게 한다. 우리는 이 시작 시스템이 Cyber 판매 전문가 시스템(Cyber-SES)이라는 이름으로 실제로 제대로 수행 됨을 확인 할수 있다.

1. 서 론

인터넷은 고속 정보 넷트워크 로서 가장 잘 알려져 있는 시스템 이다. 또한 인터넷은여러분야에 새로운 발전 기회를 주는 시스템 이다. 세계에 있는 모든 사람에게 정보를 알려주고 모든 대륙을 하나로 엮어준다. 인터넷은 인간의 생활을 크게 변화 시키고 있다, 즉 인터넷을 상거래에 사용 함으로서 산업의 주류를 이루는 쇼핑, 무역, 금융시장, 증권시장 또는 보도산업은 물론, 에약문화, 교육, 오락에 이르기 까지 영향을 주고 있다.

선진국에서는 이미 광범위 하게 컴퓨터 써비스를 기본으로 하는 비디오 온 디맨드, 홈 쇼핑 등과 같은 써비스로 인터넷을 상업화 하고 있다. 즉 열거 하면 다음과 같다.
E-메일, EDI, 정보의 출판, 정보의 검색과 VIDEO 연관 산업, 전자 상거래 상점, 전자 지불 시스템, 싸이버 은행, 싸이버 증권. 이러한 예에서 보듯이 우리의 실생활에 인터넷이 주는 영향은 점점 커지고 있다. 인터넷은 우편 서비스, 전화 시스템, 연구 도서관, 수퍼 마켓 과 토크 쇼 쎈타 에서 구매 정보를 공유 하지 못하는 사람에 이르기 까지에 있어서, 독특한 조합 환경을 보여주고 있다. 인터넷의 성장률은 역시 놀랄만하다. 공공 접속 전산 넷트 워크가 같는 새로운 사용자들 의 모든 종류는 많거나, 적거나 간에 인터넷 상의 장점으로 개발된다.

인터넷의 광범위한 적용 범위 중에서도, 싸이버 쇼핑에 관해서 만은, 인터넷을 통한 새로운 마켓트 채넬 방식의 최신 판매, 구매 방법이라고 말하지 않을수 없다. 많은 방법들이 최근에 대화식 홈쇼핑 시스템에 대하여 언급되고 보고되어지고 왔다.

회사들은 구매 요구와, 세일스 비율이 엄청나게 올라가고있고, 인간의 판매활동이 더는 가능 하지 못할정도로 어느 한계까지 다다르고 있다.

그럼에도 현존하는 양방향 홈 쇼핑 시스템은 말 하자면 데이타 베스 범주에서 벗어나지 않고, 그것은 상품의 관한 데이타를 양방향으로 찾아 내는 것을 뒷바침 해주는 것이 주된 방식인 것이다.

그러나 데이타베이스 접근 방식은 구매자의 개인적인 선호를 구조적으로 만족 시키지 못하므로, 구매자의 요구에 맞는 상품 선택을 도와 줄수 있는 전문가 시스템을 개발하기에 이르렀다.

제약과 규칙 만족 문제 (The Constraint and Rule Satisfaction Problems: CRSP) 기법 접근 방식을 사용 하여 구매자의 취향과 제약에 쌍방의 계시를 만족 시키 도록 하였다.

유닉크 셀일스맨 전문가 시스템 (The UNIK-Salesman Expert System: UNIK-SES)는 몇년전에 개발되어, 인터넷 상에서 이러한 모든 요구를 충족 시킬수가 있었다.

UNIK-SES 는 고객이 원하는 상품 구매를 도와 주기 위한 하나의 도구(tool)가 되었고, 전자 상거래와 연관 되어 기술적이고, 관리적이고, 표준화 와 규칙적인관점에서 연구가진행 되었다. UNIK-SES 를 개발하는 데에는 두가지 문제점이 도출 되었는바, 그 하나는 개발 언이 인데, LISP 언어를 사용하였으나 시스템을 충분히 수행 시키기에는 역부족이 었다. 제한적이기는 하지만 푸로토 타입으로서 신사복 판매를 취급하는 시스템을 개발 하였다. 다른 하나의 문제점은 데이타베이스와 연관되어 항상 이려운 문제로 되고 있는 속도의 문제로서 여러가지 연구를 통하여 알려져 있는 이러한 활동을 위한 기능인 것이다.

그리하여 개발된 싸이버 쎄일스맨 전문가 시스템(Cyber-Salesman Expert System:

Cyber-SES)은 판매 툴로서는 첨단을 가는것이며, 전자 상거래에 있어서는 중요한 핵심적인 역활을 할것이다.

이 주제에서는 소매에 있어서 CYBER-SES 를 사용하여 검증을 하려 한다. 소매물론 구매자에게 상품을 직접 선택하여 공급자가 공급하게 된다. 구매자의 요구에 알맞는 상품을 구매자가 선택할수 있도록 도와주는 전문가 시스템을 만들기 위하여 많은 연구가 수행되어 왔었다. 전문가 시스템이야 말로 전자 상거래의 넷트워크 상에서 특별한고객의 요구에 알맞게 소매에 있어서 상품을 선택 하여 줄수 있을것 이다.

2. 시스템의 개발

현행의 홈 쇼핑 시스템의 한계점을 극복하기 위하여 Cyber-Salesman Expert System 을 설계하고 개발하기에 이르렀다. 이를 충족시키기 위하여 다음과 같은 목표의 달성이 필요하게 된다.

1) 상품, 고객의 요구, 셀스맨의 전략을 표현 하여야 한다.
2) 대화 형식의 수행 절차를 개발하여, 고객 이 짧은 시간 안에 유연한 거래로서 만족하는 결과를 얻을수 있개 하는 것이다.
3) 인터넷 상에서 아이디아를 수행 할수 있는 수단을 개발 한다.
4) 실제로 사용할수 있는 실용적인 접근과 시스템의 효용성을 보여준다.

칫번째 두 목표는 제약과 규칙 만족 문제 (Constraint and Rule Satisfaction Problem: CRSP)를 적용하여 상품의 효용성과 가격 사이에서 쌍방향 거래를 할수있게 하므로서 동시 다발적 추론 기술로서 표현 할수 있을것이다. 과거에는 형상(Configuration) 시스템 은 규칙 기반 이나, 제약 기반의 표현 을 적용하였다. 이러한 모양으로된 표현의 한계점을 극복 하기 위하여 우리는 제약과 규칙 만족 문제(CRSP) 의 쌍방향 표현 방식을 적용 하고 있다. UNIK-CRSP 는 일반화 된 툴(Tool) 로서 동시다발적이고, 통합적이고, 쌍방향 추론 할수 있는 것이다. 이것은 UNIK-CRSP 를 아주 적절한 툴로서 사람들이 필요로 하느데에 적합하게 해주므로서 구매자가 상품을 창조적으로 형상화 하는데에 자연적으로 도와주게 된다.

우리는 UNIK-CRSP 를 응용분야의 특별한 툴로서, 즉 전문가 시스템으로서 사용자 적격의, 대두되는 상품의 선택을 추가적인 형태로서 개발 하였다. 이러한 접근은 정보 수퍼하이외이 상에서 구매자에 보조나, 전자 상거래에서 대단히 유용한 것이라는 것이 증명 되었다.

사용자의 요구 조건은 형상화 작업에 칫번째의 문제인 것이다. 구매자가 상품에 관하여 잘 알게되면, 더욱 자세하고 정확하

게 형상화 하려고 한다. 그러나 구매자의 상품에 대한 지식의 한계가 있는 것이다.

만약 구매자가 본인의 특별한 필요가 있는 경우에 상품에 대한 정보를 잘 모를 경우에는 아무리 좋은 Cyber- SES 라고 하여도 형상화 써비스가 어렵게된다. 그러므로 지식의 보완이 추가로 필요하게 되며, 이렇게 되므로서 필요한 대화형식을 이행시키게 된다.

우리는 World Wide Web 이 보편화 되기 이전에 이 연구를 시작하였다. 그때에는 한국 안에서 하이텔이나, 천리안 또는 나우누리등과 같은 PC 환경 하에서 전문가 시스템으로서 사용 하려고 시도 하였다. 그러나 World Wide Web 의 출현으로서 판매 전문가 시스템 연구에 대단한 도전과, 시도와 기회가 주어지기 시작 되었던 것이다. 그리하여 우리는 여기서 이 현상의 세번째의 새로운 목표를 설정하여 판매전문가 시스템의 구조를 이 목표에 맞도록 조정 하였다. 예를 들면, 사용 하던 개발 언어를 LISP 에서 C++로, 또 여기에서 Java 로 변경 하였던 것이었다.
이 변화로서 경쟁적이고 진보된 WWW 기술에 맞도록 빠르게 적용된 것이 었다.
판매전문가 시스템에 있어서 상업적 사용을 위하여 적절하게 개발된다는 것은,연구의 결과를 실생활의 문제를 해결 한다는 획기적인 일일 것이다. 이를 위하여 우리는 문제의 네번째 목표를 만족하기 위하여 남성복 과 오디오/비데오 의 응용 시스템을 시도 하였던 것이다.

판매 전문가 시스템은 지식 집약적인 시스템으로서재빨리 변화하는 환경에 잘 맞어야 한다. 그러므로 조직적인 개발 방식으로서 지식을 획득 하고 항시 충족시키는 것이 요구되어 진다.

3. UNIK-SES (UNIK Salesman Expert System)

UNIK-SES 은 고객이 요구하는 구매를 도와주는 전문가 시스템으로서 WWW 환경 하에서 남성복을 위한 시스템이다. UNIK-SES 를 쌍방향 으로 구매자 취향 과 조건에 잘 조화되도록 CRSP (Constraint and Rule Satisfaction Problems) 접근 방식을 사용 하였다.(Lee & Kwon 1995)

UNIK-SES 는 다섯가지 모양의 지식을 적제 하고있다. 상품 데이터베이스, 구매자 데이터베이스, 구매자와 상품의 제약조건, 구매자와 상품의 규칙조건, 판매 전략적인 규칙 그리고 두 추론 방식을 포함하고 있다. CRSP 엔진(Engine) 은 상품의 규격을 형상화 하고, Product Matchmaker 는 주어진 상품에 요구에 맞도록 찾어 내는 역활을 한다. 도표 1. 에서는 시스템에 기능적인 구조를 보여주고 있다. 시스템 안에 내재되어 있는 제약 과 규칙은 구매자의 선택에 따라서 으견과 충고를 구매자에게 전달 하여 상품 선택의 형상화를 시켜주는 역활을 한다. 이것은 후보/ 비판/조언을 할수 있는 구매자의 모델이라고 말할수 있는것이다.
UNIK-SES 는 CGI C 프로그램 으로서 구동하고, 사용자 적격의 형태로서 HTML FORMS 을 사용하고 있다. 프로토타입 으로 만드러진 지식 베이스 UNIK-SES 는 25 개의 제약과 10 개의 규칙을 가지고 있다.
HTTP(Hyper Text Transfer Protocol)은 쉽게 표현할수 없는 프로토콜이다. 그러므로 UNIK-SES 에서는 HTTP Cookies (Netscape, 1995)를 사용 하여 정보를 표현하고, 사용자 특수의 Fact Base 를 구현 할수 있다.
그러나 JavaScript 가 Browser 에 구매자 입력의 효율을 높여서 네트워크 의 교통을 원활히 하기 위하여 사용 될것이 요구되고 있다.

테이블 1. UNIK-SES 와 Cyber-SES 의 비교표

UNIK-SES
Started before the invention of WWW (designed for use in PC communication)
Emphasis on applying CRSP to Purchasing Support
Conversion from LISP to C
Server-Intensive Computation
Applied to Men's wear case

Cyber-SES
Designed considering available WWW technology
Emphasis on proper architecture in WWW
Java
Client-Intensive Computation
Applied to AV case

Figure 1. Functional Architecture of Salesman Expert System

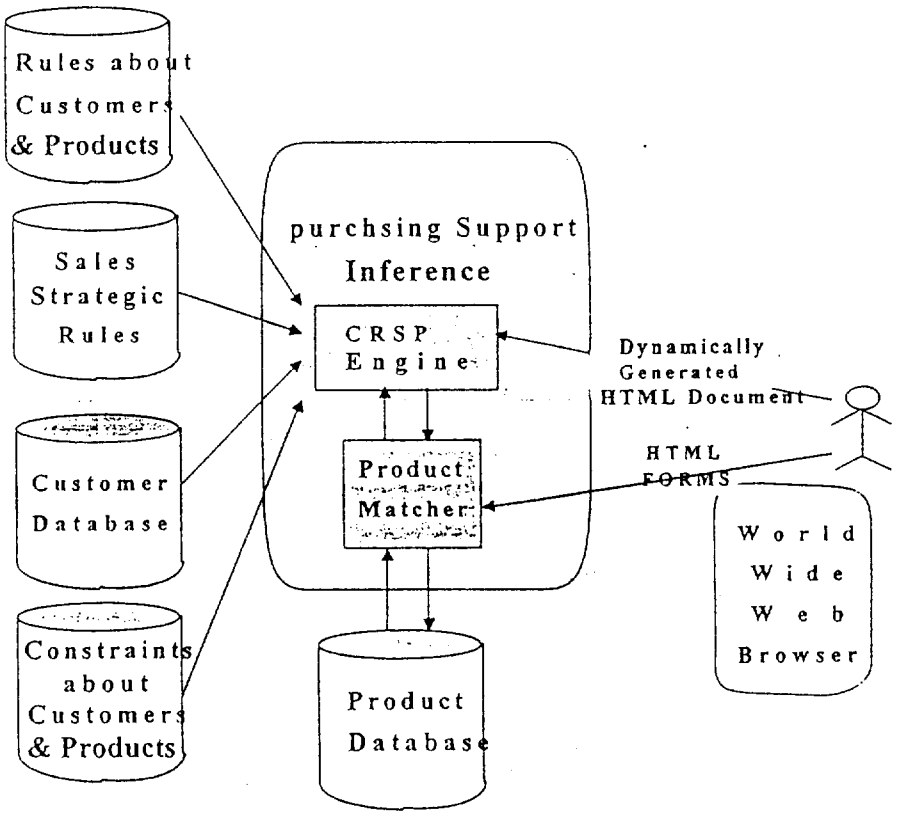
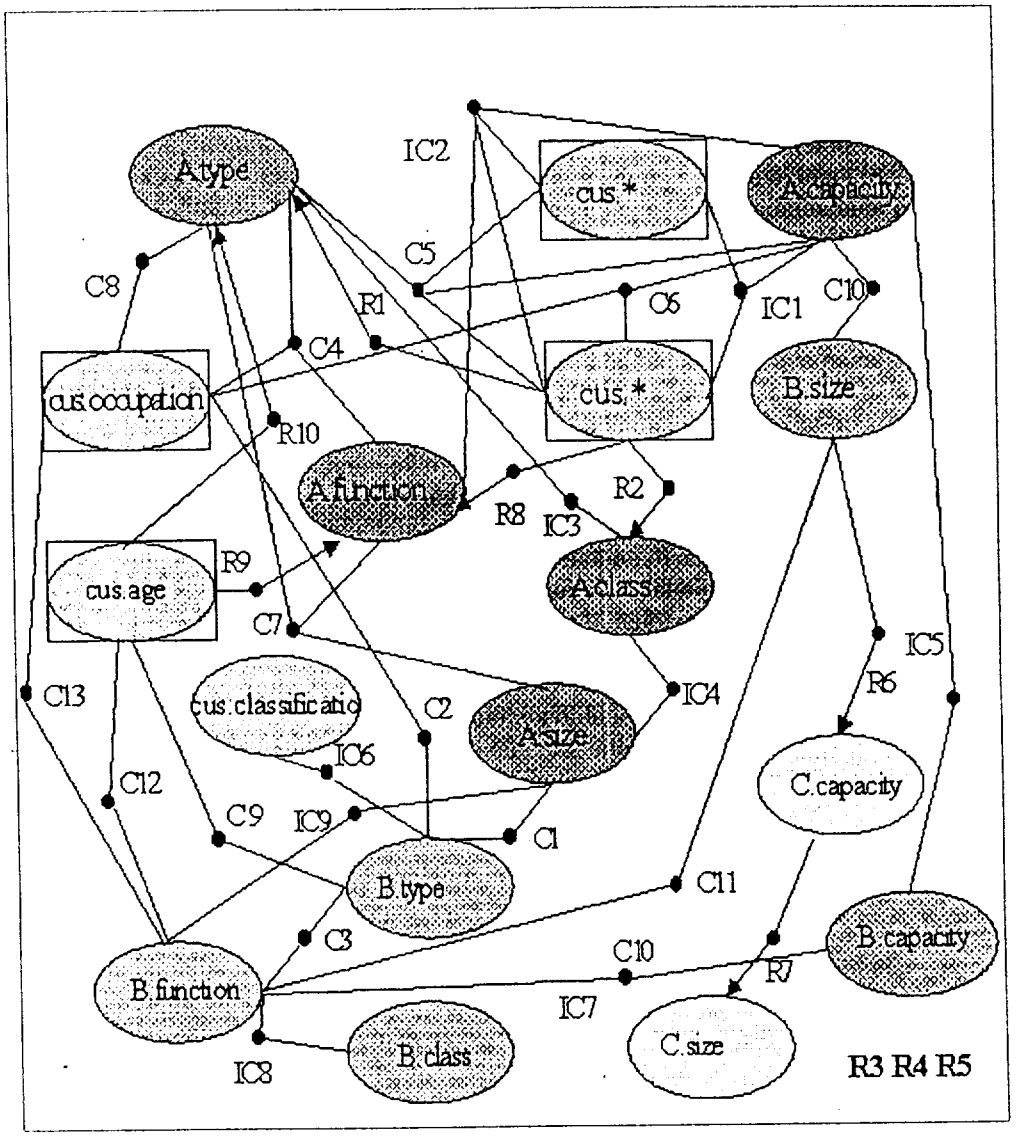


Figure 2. Constraints and Rules Graph



4. CRSP Reasoning Process for Salesman Expert System

Here we describe the architecture of the system Cyber-SES. To effectively support the customized purchasing process, the system is equipped with five types of knowledge: a product database, a customer database, constraints about customers and products, rules about customers and products, and sales strategic rules. Each of these are explained in the following sections.

The system Cyber-SES possesses of two reasoning capabilities: a CRSP Engine which configures the specification of the products and Product Database Matcher which retrieves the product component instances that meet a given requirement. The first necessity of the product database matching capability is to initialize the domain of values for each decision variable. Since the values should be updated whenever there is any change in the product database (e.g. introduction of new products, price change, and stock out), the data driven forward chaining capability is appropriate. Thus a forward chaining subsystem UNIK-FWD is employed along with UNIK-CRSP. Although the list of all possible values in the domain shows potentially possible values for each variable, it does not however mean that all the Cartesian products of the values are really prepared as physical products.

For the above reason, the product configuration process requires two classes of constraints among variables. One is an ordinary constraint between product types. For instance, the suitable sound matching between amplifier and speaker belongs to this category. The other is a constraint within a product type. The latter constraint implies that the existence of such a product instance should be confirmed. Since imposing the within-product-type constraints for each product instance is very burdensome, it is better to store the instance items in an object oriented database and go to confirm its existence. To operate in this manner, the domain of values should be dynamically arranged by retrieving the existing products that meet the user's requirement. This is the reason why the product database matching capability should be closely embedded in the CRSP reasoning process for the product specification. If the product database can be more effectively managed by a relational database, a tool Cyber-X can transform between relational and object-oriented databases.

The following steps summarize the CRSP reasoning process for the Salesman Expert System incorporating the product database matching routine.

STEP 1. [Goal Setting]

The customer selects goal variables he is interested in (e.g. types of products) and sets the desired target levels (e.g. available budget).

STEP 2. [Variable Ordering]

UNIK-SES computes the tightness of variables, and orders the variables according to the tightness measure and customer dependent variable ordering

rules.

STEP 3. [Seed Variable Selection]

The customer selects seed variables from which the concurrent reasoning starts. The seed variables may be determined either by customer's choice or by selecting the variables whose tightness is above a threshold. Set the currency to each of the seed variables.

STEP 4. [Rule and Constraint Propagation]

For each seed, propagate rules and constraints as described in STEP 4.1 – 4.4

STEP 4.1. [Rule Inference]

Perform the backward chaining inference regarding the current variable (X_C) as a root node.

STEP 4.2. [Functional Assignment]

If there exists a functional assignment constraint which has X_C as a dependent variable, compute the value of X_C by asking the values of independent variables to the customer or by deriving the values of independent variables from their associated constraints and rules. Assign the computed value to X_C.

STEP 4.3. [Value Ordering]

To propagate the associated compatibility constraints with X_C, order the values of X_C by the least constraining order criterion and customer dependent value ordering rules. Select a value of X_C to propagate with.

STEP 4.4. [Compatibility Constraint Propagation and Product Matching]

With the selected value, propagate the associated compatibility constraints with X_C one by one, considering importance of constraints according to the constraint ordering criteria.

Match the current requirement specification derived from the constraint propagation with the product database to retrieve the products that satisfy the requirement.

IF the propagation succeeds AND products satisfying the specification exist

IF the active values of the variables are changed by the current propagation,

THEN perform the truth–maintenance to keep consistency among multiple paths of constraint propagation.

ELSE move the currency to one of propagated variables and go to Step 4.1.

ELSE IF there exists a chance of backtracking,

THEN backtrack the variable by moving the currency via the traced path. Go to Step 4.1. ELSE go to Step 5.

STEP 5. [Inconsistency Elimination and Goal Trade–off]

Identify the reason for backtracking failure.

IF the failure is associated with a goal variable,

AND the adjustment of the current goal is possible,

THEN relax the goal to resolve the backtracking failure.

IF the failure is caused by the inherent inconsistency between multiple goal variables,

THEN resolve the inconsistency by negotiating between associated goal variables.

5. An Application to the Audio and Video Purchase

1) Variables for the AV Case

The decision variables for the configuration of the Audio and Video case are listed on the next page in Figure 4. In this study, we consider five product types (Amplifier, Speaker, CD-player, TV, and VTR) and two types of customer information. Each attribute concerning the products and customers corresponds to a variable. For the product related variables, when the values which meet the customer's requirement for a certain criteria are identified, the Product Matcher should dynamically retrieve the items that meet the requirement from the product database as illustrated. For each access by a customer, the customer information is initialized by retrieving the data from the customer database as the example in. The variables in the buying-plan category will be arranged for each purchase attempt. For the advanced system, we may wish to store the history of purchase and learn to guess what each particular customer may need, but this is beyond the scope of the current version.

The constraints can be classified by their structural characteristics. Note that the constraints have an importance indicator to fix their respective priority.

Figure 3. Variables in AV Case

AMPLIFIER: model-name, price, capacity, class,
brand, type, sound, size, function, inventory
SPEAKER: model-name, price, capacity, class, brand,
function, type, sound, size, surround, inventory
CD-PLAYER: model-name, price, type, brand, style,sound, size, inventory
TV: model-name, price, inches, class, brand, color, type, size, inventory
VTR: model-name, price, head, class, brand, type, sound, size, inventory
CUSTOMER: occupation, sex, income-level, age,classification, type of use, daily hours
BUYING-PLAN: total-amount, price-upper-bound,price-lower-bound, purpose, decision

Figure 4. Representation of A Product

{{LG electronic FA-960
is-a: Digital Amplifier
model-name:FA-960
price: $930
capacity: 420w
brand: GoldStar
class: A class
type: integrate
sound: stereo
size: regular-size
surround: main
function: echo
inventory: 20 }}

Figure 5. Representation of A Customer

{{ Lee, S K
is-a: customer
occupation: businessman
sex: male
income-level: high
age: 58
classification:
classical-music
type of use: main

listening daily hours:
short }}

A. Importance of Constraints in AV Case

The importance of each constraint is marked in the *importance* slot ranging between 0 and 1. "1" implies "must" , and "0" implies "do not have to". The following constraint implies that the compatibility between customer likes classics and speaker for classics must be met.

{{ Constraint-C9
Importance: 0.5
Type: compatible-value-set
Associated-variables: customer. classification speaker. type
Compatible-value-set: (classical-music 3-way) }}

B. Types of Constraints

From the structural perspective of constraints, the constraints in Cyber-SES can be classified into four types: *Value Compatibility, Value Incompatibility, Algebraic Inequality, and Functional Assignment.*

a) Value Compatibility Constraints

The value compatibility constraints are the *what-fits-what* like relationships between products. The following example shows a constraint which means that the echo of a speaker fits well with the Mic-mixing amplifier.

{{ Constraint-C1
Type: compatible-value-set
Importance: 1
Associated-variables: amplifier speaker. type
Compatible-value-set: (regular-size 2-way) }}

Some constraints represent the matching between the characteristics of customers and products based on the salesman's experience. For instance, the occupation may influence the style of a speaker as the following example, but the importance level of this kind of constraint should be weaker.

{{ Constraint-C6
Type: compatible-value-set
Importance: 0.5

Associated-variables: customer. occupation customer. type-of-use amplifier. sound buying-plan. purchasing-purpose
Compatible-value-set: (Businessman main stereo) }}

b) Value Incompatibility Constraints

On the other hands, there are as many constraints that prohibits the *what-does-not-fit-what* like incompatible relationships in the configuration domain. The following example shows an incompatibility constraint: A real aficionado isn't satisfied when he hears music played through components.

{{ Constraint-I1
Type: incompatible-value-set
Importance: 1
Associated-variables: customer. daily-hours customer. type-of-use amplifier. sound
Incompatible-value-set: (short main mono-mono) }}

c) Functional Assignment Constraints

Functional assignment constraints represent the assignment relationships between independent variables and a dependent variable. For instance, the total amount is computed by the summation of 5 price components. The reverse directional inference cannot be applied.

{{ Constraint-F1
Type: Functional-Assignment
Dependent-variable: buying-plan. total-amount
Independent-variable: amplifier. price speaker. price CD-player. price TV. price vtr. price
Relation: buying-plan. total-amount = amplifier. price + speaker. price + CD-player. price + TV. price + vtr. price }}

d) Algebraic Inequality Constraints

The budget constraint of a customer for instance, can be represented using algebraic inequality constraints.

{{ Constraint-A1
Type: Algebraic-inequality
Importance: 0.3

Associated-variables: buying-plan.total-amount buying-plan.total-amount-upper-limit
Relation: buying-plan. total-amount >= buying-plan. total-amount-upper-limit}}

C. Rules in AV Case

a) Customer and Product Rules

The rules used in Salesman Expert System can be classified into customer and product rules and sales strategy rules.

b) Customer and Product Rules in AV Case

While a constraint grabs the *what-does-not-fit-what* kinds of relationships without any directional nature, a rule has a directionality such as "if it is going to have good equipment, the system should not have any off brands." The reverse relationship in general does not hold. Another rule might be that a aficionado should use complicated equipment. They are illustrated in the following rule form:

{{ Rule-1
IF (Amplifier. model IS dual) THEN (speaker model IS 3-way)
Importance: 1 }}
{{ Rule-2
IF (customer. hobby pop-song)) THEN (amplifier. model all-in one)
Importance: 0.5 }}

The role of importance slot in the rules is the same as the one in the constraints.

D. Sales Strategy Rules for Variable and Value Ordering

Sales strategies are represented as variable and value ordering rules which play the role of meta-rules in CRSP reasoning.

a) Variable Ordering Rules

An experienced salesman may ask a student customer the affordable price range first, but may ask a 40 year old customer whether he wants a classical or easy-listening system first. Putting questions in the right sequence is essential know-how for business success. In CRSP terms, the sequencing of questions is

the variable ordering. Examples of variable ordering rules are as follows.

{{ Variable-ordering-rule-1
IF (income-level IS high)) THEN (seed. variable IS brand)
Importance: 0.5 }}

{{ Variable-ordering-rule-2
IF (occupation IS student) THEN (seed. variable IS price)
Importance: 0.5 }}

b) Value Ordering Rules

The value ordering means which value the salesman is going to suggest first out of many alternative values for a certain variable. For instance, in the case of businessman, the type of amplifier is given by the following sequence: *dual integrated all-in-one.*

{{ Value-ordering-rule-1
IF (customer. occupation IS businessman) THEN (amplifier. classification IS (ORDER classical-music easy-listening jazz))
Importance: 0.7 }}

E. Reasoning Procedure in Cyber Salesman Expert System

In this section, we illustrate an exemplar reasoning with Cyber-SES. Although the dialogue will be assisted by the menu driven windows, we illustrate the reasoning process with rules and constraints to show the logic behind the screen. Let's suppose the customer who is going to buy a amplifier, a speaker, and CD-player. This means that he will selects the goal variables of a amplifier, a speaker, and CD-player, which corresponds to the Step 1 in section 3.

(Customer
(Occupation: businessman)
(Sound: mono-mono)
(Age: old)
(Classification: classical-music)
(Type-of-use: Main))
(Buying-Plan
(Purchasing-purpose: listening to classical-music))
(Goal
(Target-variables: amplifier speaker CD-player))

Let's assume the customer doesn't set any values on the seed variables.

The system Cyber-SES begins reasoning with its knowledge and default strategy to generate values from Step 1 to 5.

> Step 1.

{{ RULE-1 IF (customer. classification classic-music) (customer. type-of-use main) THEN (amplifier. type integrated)
Importance: 0.7 }}
=> (amplifier (type integrated))

> Step. 2.

{{ RULE-9 IF (customer. type-of-use main) THEN (amplifier. class normal)
Importance: 0.5 }}
=> (*amplifier. class normal*))

> Step. 3.

{{ RULE-C8 IF (customer.occupation (businessman))
(Buying-Plan. Purchasing-Purpose easy-listening)
THEN (amplifier. sound (stereo))
Importance: 0.4 }}
=> (*amplifier. sound (stereo)*))

> Step. 4.

{{ RULE-C9 IF (customer. sound stereo) THEN (speaker. sound stereo)
Importance: 0.3 }}
=> *(speaker (sound stereo)*

> Step. 5.

{{ RULE-C12 IF (customer. age old) THEN: (speaker. type 3-way)
Importance: 0.5 }}
=> (speaker (type 3-way))

Up to now, Cyber-SES has automatically generated the specification for the customer using rules. In step 6, the system finds there are no applicable rules although there are still variables left to be determined such as amplifier model, speaker model, and type of CD-player, etc. In this case, there are two options to continue the inference. One is constraint propagation by ordering the undetermined variables and assigning their values according to the value ordering strategy. The other is interactive reasoning with the customer by requesting the customer to select values for the variables he wants. In this example, suppose that the customer selects 'Mini Component' for the model of amplifier, □-way□for the model of speaker, and □lassical-music□for the classification of amplifier. Then the system begins reasoning with these newly inputted values.

> Step. 6.

"There are No Applicable Rules. "
(User-input: 'amplifier 'size 'regular-size)
(User-input: 'amplifier 'function 'aficionado)
(User-Input: 'speaker 'surround 'main)

=> (amplifier (type integrated) (class normal) (size regular) (function aficionado))
=> (speaker (sound stereo) (type 3-way) (surround main))

But, the input value violates the incompatibility constraint-I1 that the normal integrated amplifier does not match with sensitive 3-way speakers. In such a case, the system shows the incompatibility constraint and recommends other possible values on the model of amplifier. Of course, the customer can adhere to his original decision. In this example, suppose the customer selects 'dual' choosing a preamplifier and power amplifier set, for his amplifier and the system resumes reasoning with the changed value.

> step. 7.
"Constraint I1 is violated"
{{ CONSTRAINT-I1
Importance: 1
ASSOCIATED-VARIABLES: customer. daily-hours customer. type-of-use amplifier. sound
INCOMPATIBLE-VALUE-SET: (short main mono-mono) }}

(User-input 'amplifier 'function 'echo)
=> (amplifier (type integrated) (class normal) (size regular) (function aficionado))
=> (speaker (sound stereo) (type 3-way) (surround main))
> step. 8.
{{ RULE-6 IF (speaker. surround main) THEN (CD-player. type regular)
Importance: 1}}
=> (amplifier (type integrated) (class normal) (size regular) (function aficionado))
=> (speaker (sound stereo) (type 3-way) (surround main))
=> (CD-player (type regular)
> step. 9.
{{ RULE-7 IF (CD-player. type regular) THEN (CD-player. (one-touch CD-single))
Importance: 0.8 *}}*
=> (amplifier (type integrated) (class normal) (size regular) (function aficionado))
=> (speaker (sound stereo) (type 3-way) (surround main))
=> (CD-player (type regular (one-touch CD-single))

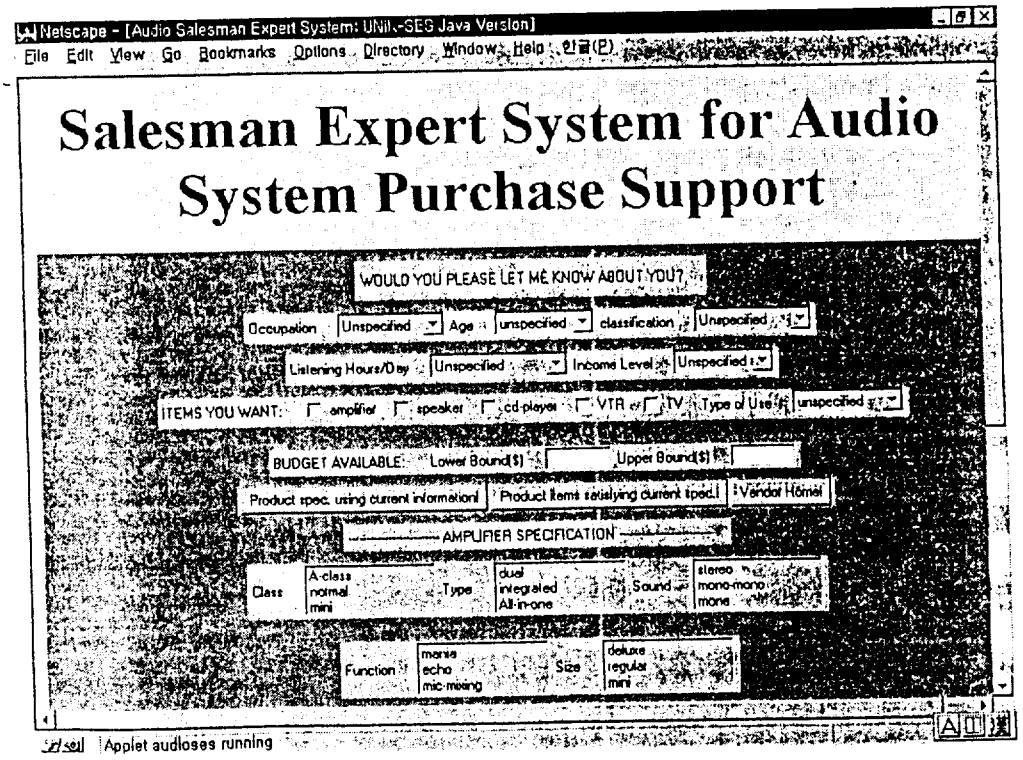
At any step, the customer may stop the reasoning and accept the currently suggested items. The system then stops reasoning and displays the resulting specification of the customer's choice.

```
> Step. 10
(user-input: 'Buying-Plan 'decision 'yes)
=> (amplifier (type integrated) (class normal) (size regular) (function aficionado))
=> (speaker (sound stereo) (type 3-way) (surround main))
=> (CD-player (type regular (one-touch CD-single))
```

For every step of the inference, a user friendly interface is a requisite because the system has to be directly exposed to the customers. So the implementation employs multimedia windows. The figures illustrate a screen of Audio and Video equipment specification.

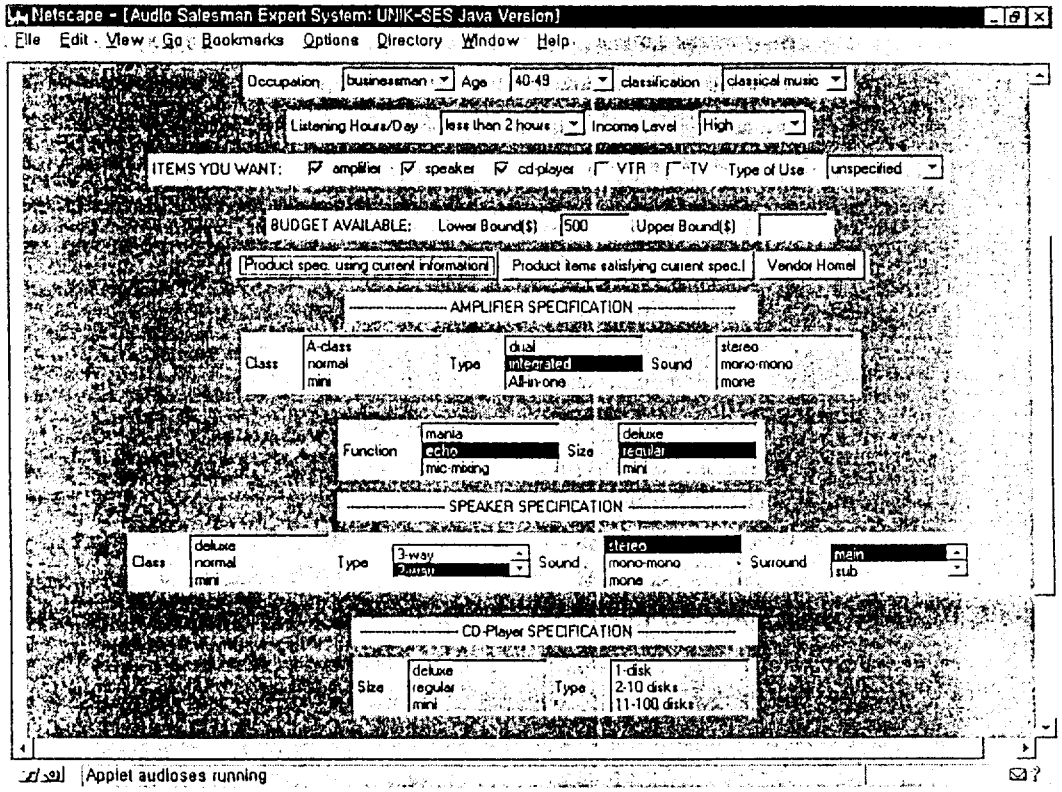
For the given specification, Cyber-SES can display the combination of amplifier, speaker and CD-player in a multi-media based screen as illustrated in Figure 10 on the next page. Upon reviewing the display, customer may select the combination as a final decision or may request Cyber-SES to resume the reasoning process to modify the current specification.

Figure 6. Customer Input Screen Using Java Interface (Cyber-SES)



It is indeed, on the web browser we developed Cyber-Salesman Expert System with HTML (see Appendix C) and JAVA (see Appendix D). Previously we developed Cyber-SES with HTML (see Appendix A) and UNIK C++ (see Appendix D)and use gateway as a CGI program, we gave up this system, because we were not satisfied with Speed. On this Figure 12, there are questionnaire to customer Would you Please let me know about you? so customer should input information about themselves, such as Occupation, Age, Classification, Listening Music/Day and Income Level etc. Also Budget Availability for Lower Bound and Upper Bound.

Figure 7. Intermediate Specification



When customer input businessman of Occupation, 40-49 of Age, Classical Music of Classification, less than two hours of Listening Hours/Day, High of Income Level, Amplifier, Speaker, CD-Player of Items you wants, US $500 of Lower Bound, US $ 1,000 of Upper Bound. Then selecting switch of 'Product spec. using current information' there shows the window about recommendation as in Figure 13. Figure 14, there are recommendation messages from the salesman. Figure 15 shows the screen of selected items satisfying the current specification. If you select among one item from window of Database. You could have one selection of product.

Figure 8. Recommendation Messages

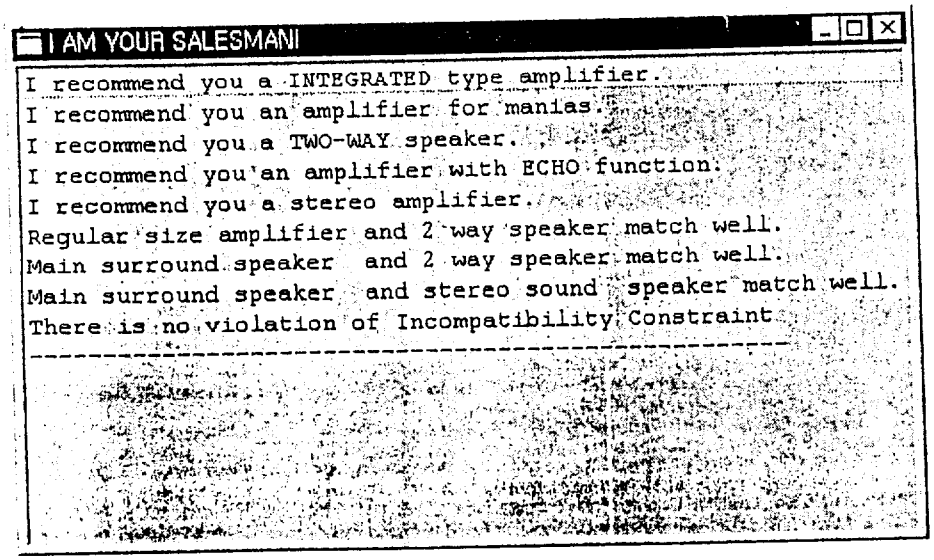


Figure 9. Product Database Retrieval

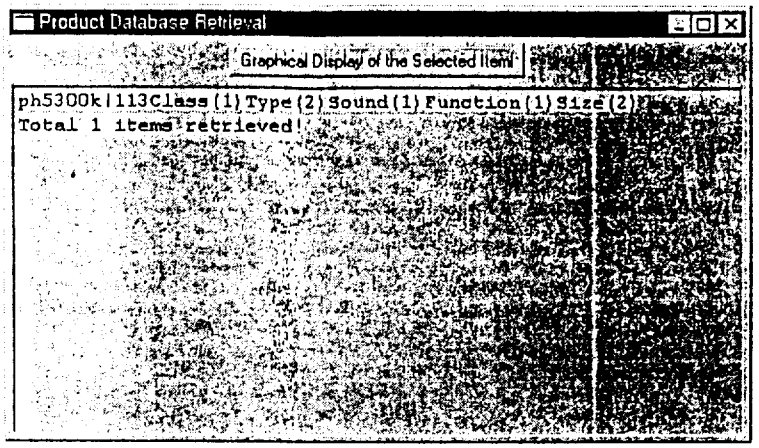
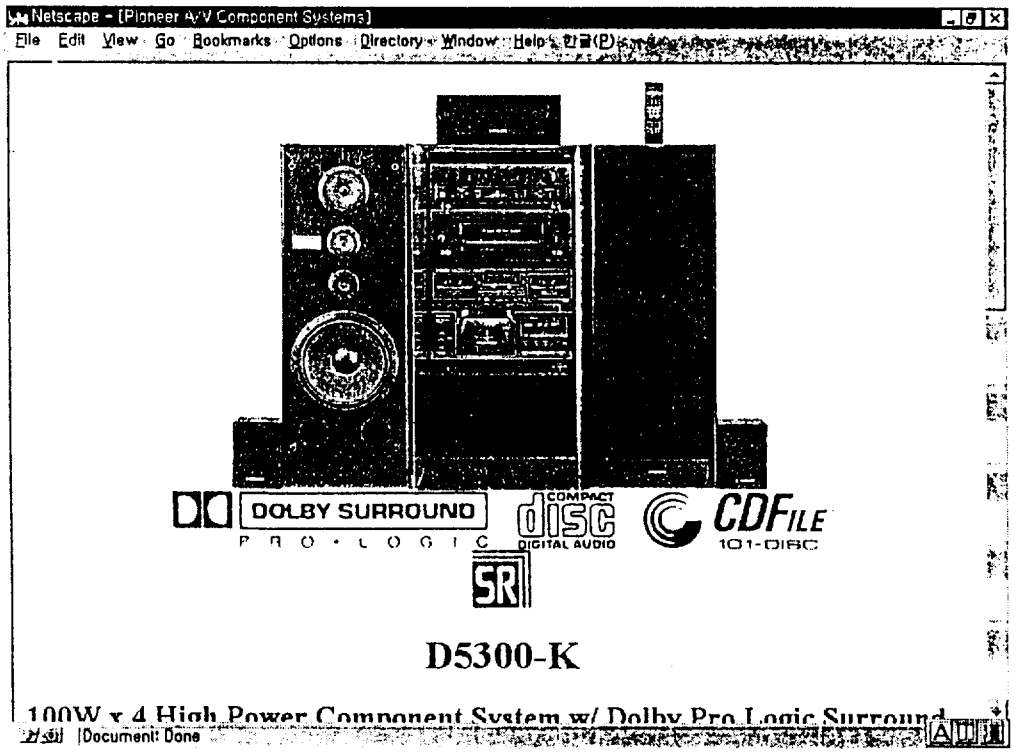


Figure 10. Display of Selected Items



6. Conclusions and Future Research

1) Summary of Contributions

We can summarize the contributions of this thesis as follows:

- Develop Cyber-Expert System using CRSP approach for the custom tailored configuration and represent the products, customer needs, and Salesman's strategy.

- Develop a template-based CRSP model generator that can be automatically generated by simply inputting the knowledge such as product variables and values, customer variables and values, Sales strategy. We have tested the validity of this approach with 10 products and confirmed its effectiveness.

- Develop knowledge acquisition and maintenance method for AV case.

- Cyber-Salesman Expert System is implemented the using JAVA to run on the Internet.

- Confirm that prototype of Cyber-Salesman Expert System performs very well on the network, such as Men's wear use with UNIK-SES and AV case with Cyber-SES.

2) Concluding Remark

We have shown that the constraint and rule satisfaction problems approach is suitable for generation of a the custom tailored product configuration. Although we have illustrated with the selection of Audio and Video equipment, the approach should be applicable for the configuration and design of many other products such as golf sets, cars, furniture, personal computers, men's wear, lady's wear, cosmetics, accessories, and jewelry. UNIK-CRSP is effective for this purpose.

To make the Cyber Salesman Expert System more intelligent, the history of individual customers could be maintained as user models. From the history, the purchasing pattern of each customer could be learned, and from the current status of possession, suitable combinations may be suggested. To run Cyber-SES under a distributed product databases environment connected via the information superhighway, the purchasing support function should be able to communicate with multiple intelligent agents that are responsible for the proposition of adequate product items priced competitively. So the integration with agents is the next issue to be investigated [Lee and Lee, 1995].

References

Benjamin, R. and Wigand, R. 1995. Electronic Markets and Virtual Value Chains on the Information Superhighway, Sloan Management Review, 62-72, Winter.

Dechter, R. and Pearl, J. 1988. Network-Based Heuristics for Constraint-Satisfaction Problem, *Artificial Intelligence*, 34, 1-38, 1988.

Doorenbos, R., Etzioni, O. and Weld, D. 1996. A Scalable Comparison-Shopping Agent for the World Wide Web, Technical Report, UW-CSE-96-01-03, Department of Computer Science and Engineering, University of Washington.

Evirgen, C., Mitri, M. and Cavusgil, S. 1995. Using Expert Systems in International Business:

Guttman, R., Maes, P., Chavez, A. and Dreilinger., D. 1997. Results from a Multi-Agent

Kalakota , R. and Whinston Andrew B. 1996. Frontiers of Electronic Commerce: *The Internet as a Network Infrastructure, The Business of Internet Commercialization, Electronic Commerce and the World Wide Web, Consumer-Oriented Electronic Commerce.*

Kumar, V. 1992. Algorithms for Constraint-Satisfaction Problems: A Survey, *AI Magazine*, 13(1):32-44.

Lavency, P. and Vanhoedenaghe, M. 1988. *Knowledge-Based Configuration Management*, New York: IEEE.

Lee, J. K. and Lee, W. K. 1995. Intelligent Agent Based Electronic Marketing: UNIK-AGENT, *'95 Pacific-Asian Conference on Expert Systems*, China.

Lee, J. and Kwon, S. 1995. ES*: An Expert Systems Development Planner Using A Constraint and Rule-Based Approach, *Expert Systems with Applications*, 9 (1):3-14.

Lee, J. and Lee, W. 1997. Intelligent Agent Based Contract Process in Electronic Commerce: UNIK-AGENT Approach, Proceedings of Hawaiian International Conference on System Science.

Lee, S., Lee, J. and Lee, K. 1996. Customized Purchase Supporting Expert System: UNIK-SES, *Expert Systems with Applications*, 11 (4): 431-441.

Liebowitz, J., "Expert Configuration Systems: A Survey and Lessons Learned", *Expert Systems With Applications*, vol. 1, pp. 183-187, 1990.

Linden, G., Hanks, S. and Lesh, N. 1997. Interactive Assessment of User Preference Models: The Automated Travel Assistant, Submitted to User Modeling1997

Mackworth, A. K. 1986. Constraint Satisfaction, in *Encyclopedia of AI*, S.C. Shapiro (ed.), 205-211.

McCann, J. and Gallagher, J. 1990. *Expert Systems for Scanner Data Environments*, Kluwer Academic Publishers.

O'Leary, D. 1995. Some Privacy Issues in Knowledge Discovery: OECD Personal Privacy Guidelines, *IEEE Expert*, 10 (2).

Perkowitz, M., Doorenbos, R., Etzioni, O. and Weld, D. 1997. Learning to Understand Information on the Internet: An Example-Based Approach, Forthcoming in the *Journal of Intelligent Information Systems*.

Petrie, C. 1996. Agent-Based Engineering, the Web, and Intelligence, 24-29.