Admission Consultation System
based on Intelligent Multi-Agent System

Dong-oun Choi
Division of Information and Electronic
Commerce Wonkwang University
(cdo209@wku.ac.kr)

Soo-yong Kim
Division of Information and Electronic
Commerce Wonkwang University
(provibe@empal.com)

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Cyber education fields have been changed a lot with the internet development. One of them is the field of consultation for university admission. As for the business of university admission, there were two ways applicants handed in their applications directly to school which they applied to and to each place to receive applications or sent them through FAX. Recently, highlighted is the internet environment to receive the application for admission which integrated organically the two ways. This paper aims to design and implement a multi-consulting-agent system having intelligence which helps applicants make their right applications for colleges or universities through internet system after guiding a proper department to them.

1. Introduction

Universities of today are on an increasing trend of adopting on-line application to organically integrate the entrance examination administration affairs(Uway, 2005). The existing application for admission is the system to look through the application forms (through hands) which are received by visit to school (school tour), by mail, and on business trip. It not only costs sundry expenses including traffic expenses but also is restricted by space and time as well as excessive expenditure of management expenses, and causes the administrator to feel the stress of conducting a business through hands and to groan under a heavy burden. The on-line application is a solution to these problems. The on-line application via the professional organization (agency) is widely generalized. Uway(Uway, 2005), Apply Bank (Apply, 2005), and Apply114(Apply, 2005) etc. execute as proxy for the agency of application for admission. Because the applicants are characterized

by coming in groups for submitting in the short while required, the university authorities can have the expected value to cut down expenses needed for manpower supply or booth-furnishing. The on-line application in itself, having an effectiveness of indirect advertising as a medium of advertisement, can meet expectations of the retrenchment of the expenditure. Collected data which has been taken over by computers can also cut down on additional expenses to equip the computerized system. With the wide spread of the computer, applicants of today prefer to the on-line application, Universities are accepting on-and off line applications submitted through the various systems. The online application will not only save students some time but also select the department to which they will apply via intelligent agent, and the university authorities would be convenient to receive well in advance.

In this thesis, I designed and implemented on-line admission consulting multi-agent system. That examinees can apply for safely and according to their conviction by recommending the university course suitable for their academic aptitude and test scores with test scores and a university grade report on students' record using intelligent multi-agents and through a university course recommending wizard in the process of choosing it.

Chapter 2 in this thesis deals with related studies, chapter 3 explains the design of the intelligent university course recommendation system, and chapter 4 describes its implementation. Finally chapter 5 discusses the conclusion and

further issues to study in the future.

2. Related study

2.1 The limitation of an existing application system based on web

As shown in [Fig. 1], on-line application is performed through the process of 8 stages without consultation function. Web server perform only an interface for examinees to fill out the application form, and once they finish filling this out, the work with application server is proceeded. In the application server, every modules related to a database are installed. Although the existing on-line application broaden the range of an excellent examinee's choice by overcoming the limit of time and space with the internet, but the lack of consulting function refrains applicants from applying to the department they want. y test to the restrictive condition about the entrance requirements and application data, but there is a difficulty in administering the test because of the lack of understanding of peculiarity and environment of the college and of smooth communication. Especially, examinees can not verify which score is more advantageous to them, the College Scholastic Ability Test score or the school report on a student's grades and conducts, and there is no way to verify whether their College Scholastic Ability Test score is suitable for the entrance requirements of the college to which they want to apply.
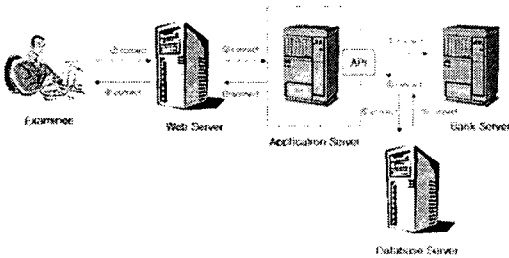
[Fig. 1] Structure of Existing Online Applications

Therefore, the existing on-line application system has functional limitation as follows:

1) It cannot handle the data deadline quickly.

2) The duplication of work occurs because of making a confirmation call from students and immature operation after the receipt of application.

3) The shortage of information on the college entrance requirements because of a lack of consulting function.

4) It can not check the possibility of entering the specific school course compared to their scores because of a lack of consulting function.

5) It cannot make examinees apply for colleges according to their conviction and safely because of a lack of consulting function.

6) The existing on-line application system increases the possibility of the overlapping of application because of a lack of consulting function.

3. The design of intelligent multi-admission consulting agent system

3.1 The structure of the system

The structure of an intelligent admission university consulting agent system that this thesis proposes is as follows.
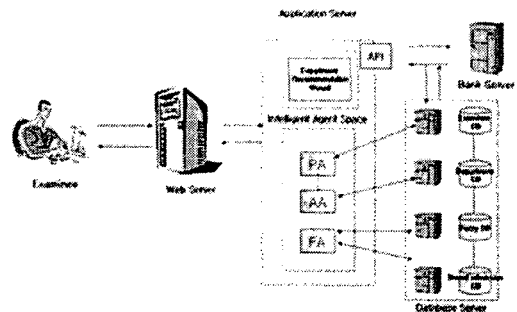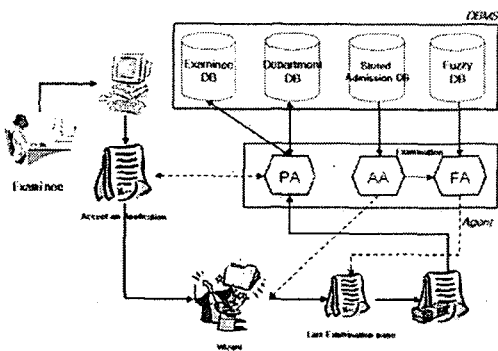

[Fig. 2] Admission Consulting Intelligent Agent

As shown in [fig. 2], it can be divided into intelligent agent space and database space, and users and the extraction machine of characteristic information; the extraction machine of characteristic information can be divided personalization agent and analysis agent in detail(Ting et al, 1998)(Katia, 1998). Analysis agents take charge of the way of recommending the university courses based on the information of examinees. Analysis agents recommend the suitable university courses to the examinees' test scores through fuzzy(Zadeh, 1965) agent and communication after analyzing examinees' information. Fuzzy agents interact with analysis agents and recommend the university courses through the algorithm for inferring the suitable

university courses to the examinees' test scores. At this time, examinees can choose only a specific university course among recommended ones optionally. If examinees choose university courses optionally without getting recommendation, analysis agents show examinees the result or other recommendable university courses at the final stage after administering an aptitude test by university courses by means of algorithm of inferring the suitable university courses. The algorithm of inferring the suitable university courses inspect the most suitable university courses to examinees by examining the data for entrance examination stored for three years. And the characteristics inspection inspects recommendable university courses with examinees' input information and the characteristic of entrance requirements of colleges. This is the process of filtering general information about entrance examination for a university and matters to be attended to application to examinees.

[Fig. 3] Admission Consulting Scenario

[Fig. 3] shows the admission Consulting Intelligent Agent scenario for the information flow

of system. This scenario bespeaks the all steps of the computer users including the first user. If an applicant accesses the site to get started with the online admission process, and then the screen to select the tab of 'Ga-Gun' or 'Na-Gun' button can be seen. At this time, the personalization agent maintains a database, saves the user's KSAT (Scholastic Aptitude Test Administered by the Korean Ministry) year and number, and identification number, and creates the online application instructions according to the department of KSAT. And then the wizard runs. The wizard, comparing some personal data with a data which is stored in a database, chooses departments to which an applicant will apply. It is possible to select the adequate department via the wizard without the expert knowledge.

If a user chooses the wrong department in running the wizard, the monitoring agent explains how to cope with it through the warning message. If a student classified by the department of arts and sports selects the premed department, the monitoring agent, which is watching it, explains him the wrong selection and leads him to choose another one. Having completed the department selection, the wizard inspects the status of applications submitted. After that, in case the choice is wrong, the wizard shows an applicant its feedback and recommend another department. Finally when the application is submitted and the application fee is paid, an examinee's number and a certificate for examination can be printed and applicants will be individually notified of the results of the application by e-mail.

3.2 Agent

Personalization Agent builds a database of customers' program of alma mater, year of KSAT, department of KSAT, scores of KSAT, and academic aptitude etc. when a user accesses the website to register, where establishes an ID and password. If an applicant chooses the department through the wizard, then the wizard stores the items to manage them. And the personalization agent is proxy for applicants.

Analysis Agent informs applicants of the analyzed data, which have been received from personalization agent. Personalization agent performs its duties as a guard who keeps an eye on all kinds of events of users being online, and besides, it not only writes the contents but transmits them to the analysis agent, which shows users the analyzed data. Analysis agent analyzes the contents monitored in the personalization agent and informs applicants of the wrong analysis, if any. Departments suitable for an applicant by analysis agent were a commendation by analysis agent maintaining communication with both personalization and fuzzy agent.

Fuzzy agent analyzes the data done by analysis agent to estimate the presumed department. To presume the department suitable for applicants via the ratio by types of admissions, a ratio by types of admission for the first stage, Amassed application data in the last three years for the second stage, and presuming department suitable for applicants for the third stage are analyzed.

Definition 1. Distribution of marks classified by types of admission.

Distribution of marks classified by types of admission can be formulated with using the variables of KSAT scores (α), distribution of marks by the field of subjects (β), extra-curricular achievement (γ), interview and oral (ε), practical skills exam (λ), professionship aptitude test (μ). First. As distribution of marks by KSAT scores (α) depends on the fields of the KSAT subjects, distribution of marks of the optional subjects must be applied to distribution of marks of the KSAT subjects and their weighted values by department so as not to disadvantage applicants due to marks by each field of the KSAT. The formula for distribution of marks classified by types of admission (Rt_1) is to the sum of distribution of marks by KSAT scores (α), academic achievement in high school (β), extra-curricular achievement (γ), interview and oral (ε), pracical skills exam (λ), professionship aptitude test(μ).

$$Rt_1 = \sum_{i=1}^{n} \alpha + \beta + \gamma + \varepsilon + \lambda + \mu$$

Definition 1-1. Distribution of marks of the KSAT subjects and their weighted values by department

$$\alpha = \sum_{i=1}^{n} (X_i + R_p)$$

Assume α ⇒ distribution of marks by KSAT scores, X_i ⇒ distribution of marks of the KSAT subjects and their weighted values by department, R_p ⇒ the ratio of distribution of marks for the first

stage faculty portions

$$Xi = \sum_{n=1}^{6} (a+b+c+d+e+f)$$

Assume a ⇒ linguistic, b ⇒ Analytic, c ⇒ Social studies, d ⇒ Science, e ⇒ Foreign language, f ⇒ Second foreign language, each coefficient ⇒ The ratio of distribution of marks by each field of the KSAT

Definition 1-2. Distribution of marks by the field of subjects (β)

As distribution of marks by the field of subjects (β) depends on the ratio of distribution of marks of academic achievement in high school (school records), academic achievement in high school must be calculated. The equation of academic achievement from official transcript from high school :

$$\beta = \sum_{i=1}^{n} (Xi + R_P)$$

Assume β ⇒ distribution of marks by the field of subjects, Xi ⇒ each student's academic achievement in high school, R_P ⇒ the ratio of distribution of marks by the field of subjects

$$Xi = \sum (a \times \frac{20}{100}) + (b \times \frac{30}{100}) + (c \times \frac{50}{100})$$

Assume a ⇒ distribution of marks of 20 % of the first yr records, 30% of the second yr records, 50% of the 3rd yr records, but the early graduation superior students and applicants to

KAIST after finishing the high school are variable according to the situation.

Definition 1-3. Distribution of marks of extra-curricular achievement (fields excluding subjects) Extra-curricular achievement (γ) evaluates human relationships, service spirits, internal maturity, logicality, ingenuity. This sets up an equation on the basis of 100 points.

$$\gamma = \sum_{i=1}^{n} (Xi + R_P)$$

Assume γ ⇒ the ratio of distribution of marks by the field of subjects, Xi ⇒ each student's extra-curricular achievement, R_P ⇒ Distribution of marks of Extra-curricular achievement. And, a formula for interview and oral (ε), practical skills exam (λ), professionship aptitude test (μ) is also applied to the formula of Definition 4. With using the example above, for instance, if a student in nursing college has the value of α =130.4, β = 105.6, γ =24, and ε =45, then he value of distribution of marks classified by types of admission is to 345 scores.

$$Dt_1 = \sum_{i=1}^{4} (130.4 + 105.6 + 24 + 45 + 0 + 0)$$

$$\therefore Dt_1 = 305$$

Definition 2. Total scores of subjects

A formula for accumulated admission data of each department needs average mark by all departments per year. The mean value of all departments excludes the highest and the lowest

value with due regard to the degree of difficulty and too excessive value.

$$Dt_1 = \frac{(\sum_{i=1}^{n-2} X_i)}{N-2}$$

Assume $Dt_1 \Rightarrow$ the mean value by all departments, $X_i \Rightarrow$ total scores of a combination of academic achievement in high school and overall KSAT scores by all departments, $N \Rightarrow$ the number of students by department

The amassed application data by all departments for these three years equal to:

$$Dt = \frac{(Dt_1)+(Dt_2)+(Dt_3)}{3}$$

Assume $Dt \Rightarrow$ the application results by department in the last three years, $Dt_1 \Rightarrow$ results in 1999, $Dt_2 \Rightarrow$ results in 2000, $Dt_3 \Rightarrow$ results in 2001.

For example, the mean value of the application results of the nursing department for these three years is to 340 scores.

Example: If 350 scores in 1999, 340 scores in 2000, 330 scores in 2001, then we can have

$$Dt = \frac{(350)+(340)+(330)}{3}$$

$$\therefore Dt = 340$$

Definition 3. Presuming the department suitable

It is possible to presume the department to which applicants can apply through the mean value by department subject to Definition 1 and 2. We can take dot and section presumptions as an example.

$$P = \frac{X}{N}$$

Assume $P \Rightarrow$ departments suitable, $X \Rightarrow$ score per applicant, $N \Rightarrow$ Scores by all departments

We can take a university made up of 40 departments as an example. What department can an applicant of 300 scores apply to? :

$$P = \frac{300}{40ea\ scores\ of\ Department}$$

$$\therefore P = Korean\ dept.$$

Section presumption is a formula to presume the reliable department equivalent for the specified value out of all departments.

$$P = \frac{(X-10) \le X \le (X+10)}{N}$$

(but, if necessary, ± 5, ± 2 can be accepted)

Assume $P \Rightarrow$ adjacent department, $X \Rightarrow$ value of ± 10 from a student, $N \Rightarrow$ total scores of all departments

For instance, of 40 departments in a university, we can take the following as an example : Math dept. (340), Biology dept. (290), Physics dept. (295), Korean Literature dept. (300), English dept. (305), Social Welfare dept. (310), Psychology dept. 310),... Law dept. (399). Supposing that a student marked 300 scores is looking up the department:

$$P = \frac{(300-10) \le X \le (300+10)}{40\text{ea scores of Department}}$$

$$P = \frac{(290) \le X \le (310)}{40\text{ea scores of Department}}$$

The student above can presume the department within the range of the scores from 290 to 310.
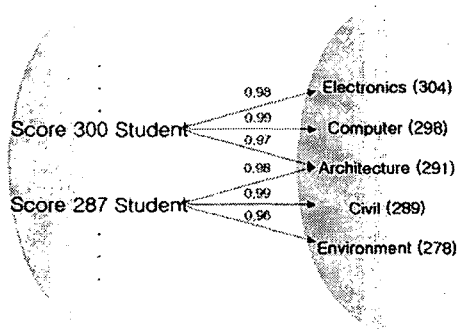
[Fig. 4] Fuzzy graph

Section presumption builds a database of the scores of inter-departments to help not only recommend the department suitable for applicants but also choose the department correctly with using the possible presuming score. Fuzzy agent in this paper ascertains whether or not the interchangeability of the inter-departments can be possible with the help of the data monitored and analysis agent's function. There is a functional difference between analysis and fuzzy agent. Supposing that there is a student called A, analysis agent, sorting out the characteristics of applicants via the characteristic inspection of analysis agent, plays the part of filtering out whether or not the

analysis agent sorts KSAT scores of the student according to the field of subjects, he is a graduate-to-be or a graduate from college in the class of 2001, and the early graduation of superior students who have finished the science high school course of two years or a new student who have finished the high school. While fuzzy agent notifies users what analysis agent carried out to stipulate for certain terms after inspecting the correlation of the KSAT scores with the department corresponding to the KSAT scores. As we can see in [fig. 4], the value of fuzzy relations between electronics and architectural engineering department to which a student got 300 scores can apply is 0.98 and 0.97 respectively.

The value corresponding to computerized information department equals to 0.99. Accordingly the computer information department is the most suitable.

3.3 Evaluation of Admission Consultation System Based on Multi-Agent

The online application via an existing agency simply acted as proxy for the applicants' application, imposing a heavy burden on applicants and university authorities in selecting the department adequate for their aptitude and scores, and producing a bad reaction to the selection of the department to lead to confusion. This system that is supplemented with admission consultation function recommends the suitable department to the applicants through the statistical data and makes up for the agency's defects so as to promote

<Table 1> Evaluation of online application programs

system classification	Uway	Apply Bank	Admission Consultation System
Consultation Function	insufficiency	insufficiency	support
Department Recommendation Function	insufficiency	insufficiency	support
Mutual help by department	imperfection	insufficiency	perfection
Application fee	application fees must be paid	application fees must be paid	No charge
Fulfillment of requirements	some	imperfection	100%
Online payments process	required about an hour for confirmation of the omission of payments	required about an hour for confirmation of the omission of payments	Active correspondence
Test	insufficiency	imperfection	sufficiency
Communication	imperfection	imperfection	100%

a high degree of efficiency on university admissions.

It is difficult to set up the optimum condition about the university because a developer manages many colleges instead of a university and its internal affairs. For instance, paying back school fees during the extra-scheduled admission periods has the difficulty in filling up a vacancy depending on how the situation develops. If a university by itself develop admission consultation system, then the university can simplify the admission procedure under the optimum condition, cut down[back] on expenses needed inputting information, and the admissions committee will determine eligibility after admissions procedure for entrance. We can expect prompt action in the admissions procedure. From applicants' point of view, the advantage of online application is that it is very convenient to provide applicants with

ONE-STOP-SERVICE including admission information, application universities, completion and submission of the application, and pay application fee online. And this system is a rapid service to cope with the completion and submission of the application, and payment within 10 minutes and save time and money as well. In addition, this system is the correct service to submit the online application via filling out and editing the supplement in advance of the deadlines. This system can maximize not only administrative efficiency of admission but the management of online applications, prevent the fallacy of contrastive analysis of documents, the loss and the damage of the application form, and dispose of a task correctly because the status of application and submission by department is subject to grasp the situation from hour to hour.

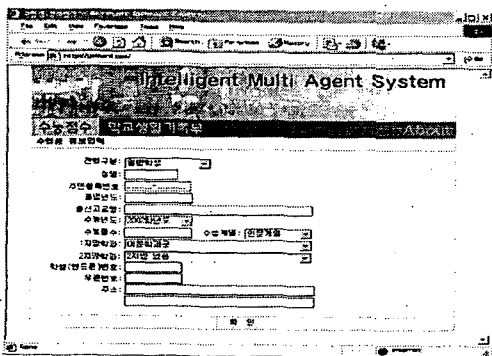# 4. The design of intelligent multi-admission consulting agent system

The admission consulting system that this thesis introduces is implemented under the environment of Linux, operated in PHP which is a script language, and a database is implemented with Informix.
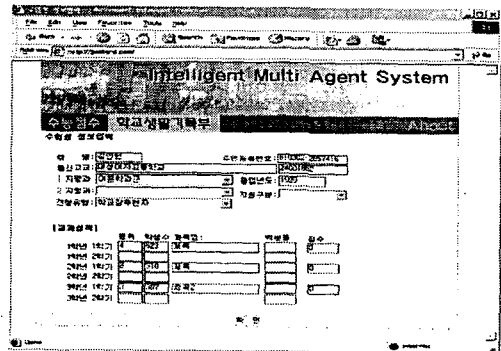
4.1 Admission consulting agent interface

Logging on, an applicant can click on the KSAT score and official script from the school within the application tab. In [fig. 5], you will see the screen on which an applicant clicked the KSAT score and department recommending wizard. Applicants may enter the year of KSAT, KSAT scores, the departments of the first and second choice, and so forth by Running the department recommending wizard. To choose departments to which applicants will apply via the high school records, it is possible to enter the high school records, departments and colleges to which applicants will apply, by selecting the wizard.

Then the process of applying to colleges can be seen in sequence of school records by a criterion for selection.
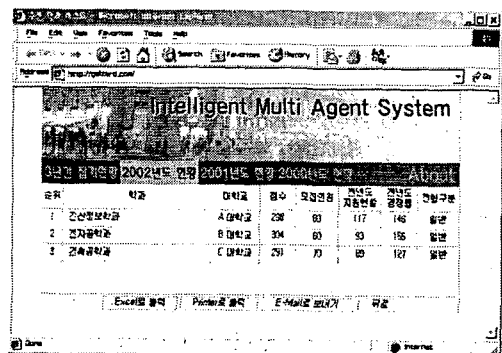
[Fig. 6] shows the screen to fill out the official transcript from high school. Applicants have only to enter the best marks of each semester. The status of application and the competitive rate of the recommended department classified by year will be provided to the applicants from hour to hour. [Fig. 7] is the result of the department lists recommended. The next is the result of application data overall for these three years. The result can be saved using Excel and received by e-mail.

[Fig. 6] Transcript

[Fig. 5] KSAT Score

[Fig. 7] Result screen

[Fig. 8] Excel Screen

5. Conclusion and Future Issue

In this paper, the admission consulting multi-intelligent agent is the system to accept online applications submitted through the department recommending wizard. There is no doubt that off-line applications are also available. The internet application for admission using the computer and the internet networks, that is, is free from the spatiotemporal restraints, can be settled the cumbersome processes of submitting the application form by the applicant in person, and it is possible (for the applicants) to give in the form via electronic settlement system at home as well as anywhere installed internet networks. The online application may refrain obnoxious customs from the existing visit application, accordingly we are hoping for the retrenchment of social expenditure of an examinee as well as an agency, which means the new internet service to use safely. The admission consulting system embodied in this paper is the system to select the department to which students will apply via multi-intelligent agent. I would like to conduct researches in building a system of wide application.

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요약

지능형 멀티 에이전트 시스템 기반의
진학 상담 시스템

최동운* · 김수용*

사이버 교육 분야는 인터넷의 발전에 의해서 많은 변화를 하였다. 대학 진학을 위한 분야가 하나이다. 대학 입시 업무 흐름에 있어서 수험생들은 학교에 직접 방문하여 접수하는 방식과 각 지역 접수창구와 팩스를 이용하여 접수를 한다. 최근에는 이를 유기적으로 통합 관리할 수 있는 인터넷 접수 방식이 각광을 받고 있다. 본 논문의 다중 진학 상담 에이전트 시스템은 대학과 학과를 선택하는 과정에서 적합한 학과를 추천하여 주는 인터넷 원서 접수 시스템을 설계하고 구현하였다.

* 원광대학교 정보전자상거래학부