Knowledge-based System for the Analysis of Habitual Substance Disorder in Adolescents

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Summary

The purpose of this study is to design the interactive diagnosis system for preventing and managing of habitual substance disorders in adolescents. Research process includes the requirement analysis, making of questionnaires, actual survey, and its analysis. Especially, this paper is about knowledge-based system to diagnose the factors of the habitual substance disorder. Our system is to diagnose and manage habitual substance disorder, especially addictions to drinking, smoking and drug. It collects answers for the questionnaires about adolescent's environment, and analyzes the factor for adolescents to fall into temptation. Our system suggests the customized solution to conquer that for each adolescent. Moreover, our system also saves the history to manage the status of each teenager constantly and to make the survey and analysis information. With our system, young boys and girls can know their seriousness of alcoholism, nicotinism, and narcotism. And they can get all possible helps through our system.

Key words:
Knowledge-based system, Knowledge base, Reasoning, Inference rule

1. Introduction

Habitual substance disorder in adolescents is very serious problem. Students smoking, drinking, and using drug increases (especially female students). Moreover, startup age is younger. For example, the percent of the smoking adolescents increases annually in Table 1.

Table 1: the percent of the smoking adolescents in Korea

	2001	2002	2003	2004	2005	2006
MH	24.8	23.6	22.1	15.9	22.4	23.8
MM	6.0	3.5	2.8	2.4	9.6	9.3
FH	7.5	7.3	6.8	7.5	13.5	13.0
FM	3.2	2.0	0.9	1.7	6.3	5.9

* MH: male high school / MM: male middle school
FH: female high school / FM: female middle school

Government, research institutes, schools, and parents try to solve this problem continuously. And many online sites are available. As the research by KIHASA (Korea Institute for Health and Social Affairs), Internet is the major source of medical information. And users using online sites for health increase. Especially adolescent is familiar with Internet and long-time user, so they have experiences to get information for health over 35%. And they likes to access personally. However, existing web sites for this provide only static and general medical information such as the danger of addictions such as smoking, drinking, and using drugs. So they are insufficient to give them customized and interactive management.

By these reasons, we research the knowledge-based system to analyze the factors of habitual substance disorder in adolescents. It provides the man-to-man analysis and. Moreover, our system is web-based user interface for users to access whenever and wherever, personally.

This paper consists of 3 additional sections. Section 2 explains the detailed design of the knowledge-based system to generate customized diagnosis and solution. Section 3 shows several simulation result and analysis. Finally in section 4, we summarize our research.

2. Design of the Knowledge-based System

2.1 System Design

The knowledge-based system is virtual expert system. Using web site, adolescents can request the diagnosis and get the customized solutions without meeting doctors, nurses, and psychologists.

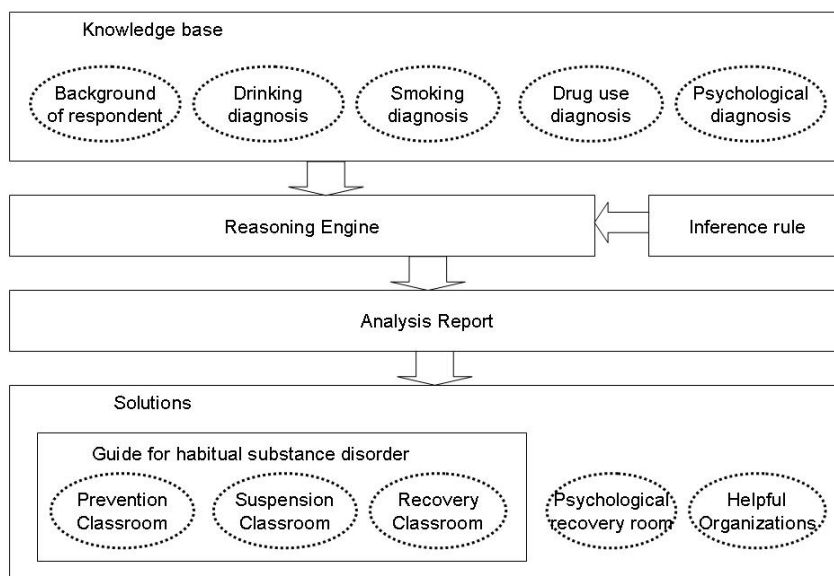We design it using knowledge base concept as showed in Fig. 1.

Fig. 1 Knowledge-based system

Our system in Fig.1 consists of knowledge base, reasoning engine (with inference rule), analysis report, and solutions.

Knowledge base has 5 categories: 'Background of respondent', 'Drinking diagnosis', 'Smoking diagnosis', 'Drug use diagnosis', and 'Psychological diagnosis'. 'Psychological diagnosis' consists of 4 characteristics: antisocial propensity, impulse propensity, depressive propensity, and uneasy propensity.

'Background of respondent' includes the respondent's environments such as smoking/drinking/drug frequency, home environment, school life, friendship, will of refusal and so on.

'Reasoning engine (with inference rule)' makes the 'Analysis Report'. Section 2.3 showed the detailed explanation about them.

To access everywhere, we make all of the 'Solutions' as web pages with dynamic image and flash item. 'Prevention/ Suspension/ Recovery Classroom' contains the interactive improvement to overcome the problem. And as the result of the psychological diagnosis, if the respondent has problems, then the system leads him/her to psychological recovery room. 'Psychological recovery room' includes the method to get rid of stress, stretching & exercise, music therapy, relaxing therapy, mediation, art therapy, writing/reading, and conversation with parents. 'Helpful organizations' include domestic and international organizations or sites.

The factors have influence on the habitual disorder directly or indirectly in Fig. 2.

Next, we make the questionnaires using the relationship in Fig.2 and previous works from [1] to [11] in Table 2.

Table 2: Questions of the factors

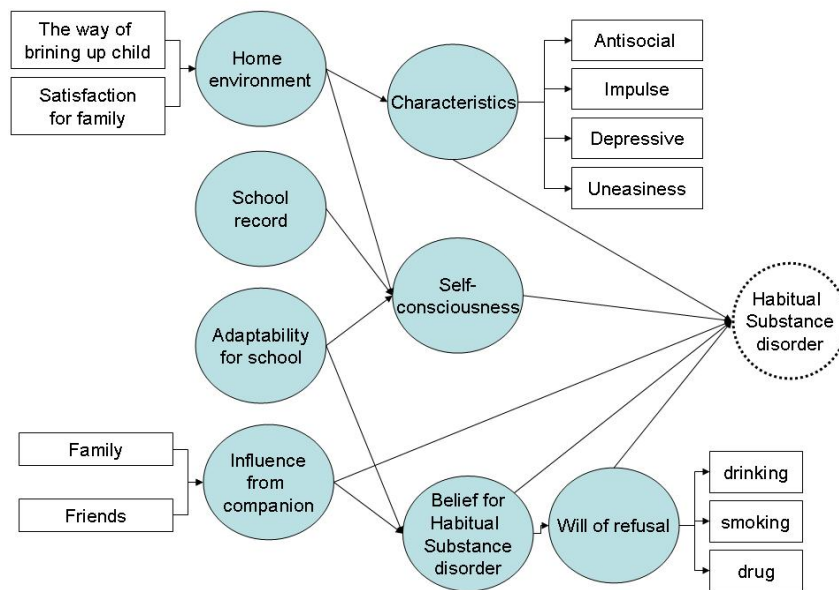| Factor	Questions
Belief for habitual substance disorder [1]	19
Will of refusal for addictions to drinking	7
Will of refusal for addictions to smoking [2]	9
Will of refusal for addictions to drug [3]	7
Home environment [4][5]	22
School record [6]	6
Adaptability for school [7]	10
Family's habitual substance disorder [8]	10
Antisocial characteristic [9]	11
Impulse characteristic [10]	10
Depressive characteristic [11]	13
Uneasiness characteristic [11]	10
Self-consciousness	20
The number of friends having habitual substance disorder	1

Fig. 2 Relationship of the factors.

The factors in Table 1 have questions as showed in Appendix. The answer of each question has 5 levels; for example, 1(absolutely no), 2(no), 3(normal), 4(yes), and 5(absolutely yes).

Each adolescent has variable environment, and that environment can be changed timely. Therefore, the influence of each factor is different among them. That is, we focus on the individual analysis.

2.2 Design of Knowledge base

Knowledge base for each factor is defined as database tables as showed in Table 3 (for example, it contains the detailed content of the belief for habitual substance disorder).

Table 3: Table design of the knowledge base (Example)

Content	The Belief for habitual substance disorder				
TableID	y_03Jindan1		Date	2008.10.27	
Col_ID	Content	Type	Length	Null	Key
NUM	Seq. #	int	4	N	PK*
ID	User ID	varchar	50	Y	
Q1	Answer 1	tinyint	1	Y	
Q2	Answer 2	tinyint	1	Y	
Q3	Answer 3	tinyint	1	Y	
.. omitted ..					
Q19	Answer19	tinyint	1	Y	
TOTAL	Sum	int	4	Y	
GETIN	Date	datetime	8	Y	

* PK: Primary Key

In Table 2, 'NUM' field is the unique sequence number of table entry. And 'ID' field contains the user identification. We use this field to make the history records of each student. From 'Q1' field to 'Q19' field are the answers for the questions showed in Part 1 of Appendix. 'TOTAL' field is the summation of the answer values from 'Q1' field to 'Q19' field. We use this 'TOTAL' value to define the status of respondent for that factor. For this example, the 'TOTAL' value below 56 means weak belief, from 57 to 69 means normal, and over 70 means strong belief. (In here, each answer for this factor has 4 level value (1~4) for 19 questions.)

2.3 Design of Reasoning Engine

The inputs of the reasoning engine are factors to have an effect on habitual substance disorder in adolescents. Those factors are showed in section 2.2.

The factors have 3 levels: *SeriousState*, *NormalState*, and *StableState*. The '*SeriousState*' level means that the influence of that factor is great, so it needs to overcome that factor. The '*SeriousState*' level means that the influence of that factor is great, so it needs to overcome that factor.

The factors have different number of questions, and different criterions to classify the state of their own factor as 3 levels. So we make the normalized criterions by transforming our index from its value into a range of 0 and 1(the maximum value of each factor). Lower bound (LB) and upper bound (UB) of '*NormalState*' as showed in Table 4.

Table 4: Criterion of the factors

Factor		LB	UB
Belief for habitual substance disorder		0.792	0.958
Will of refusal for addictions to drinking		0.571	0.829
Will of refusal for addictions to smoking		0.600	0.778
Will of refusal for addictions to drug		0.686	0.886
Home environment	Degree of acceptance	0.583	0.792
	Degree of freedom	0.667	0.875
	Degree of satisfaction	0.550	0.575
School record		0.583	0.625
Adaptability for school		0.600	0.723
Family's habitual substance disorder		0.300	0.550
Antisocial characteristic		0.314	0.545
Impulse characteristic		0.475	0.675
Depressive characteristic		0.269	0.423
Uneasiness characteristic		0.250	0.400
Self-consciousness		0.575	0.750

By above reason, the rank of the average value is not meaningful. Therefore, the reasoning engine, first of all, classifies the normalized factor values into 3 groups: *SeriousGroup*, *NormalGroup*, and *StableState*. Second, in each group, it compares the distance from the LB or UP. Then the engine generates the list of 5 top factors according to influence from '*SeriousGroup*' to '*StableState*' orderly.

3. Simulation and its Analysis

We simulate three cases: a desirable student, a normal student, and an addicted student. The analysis reports for them are showed in from Fig.3 to Fig. 5.

Fig. 3 Simulation result for a desirable student

The case in Fig. 3 shows the result of a very desirable student. Because she has no danger for the habitual

substance problem, the report gives the factors which have possibility to give her stress. In this case, if self-consciousness, belief, and freedom in family are stronger, then immunization for the habitual substance disorder is better.

Fig. 4 Simulation result for a normal student

The case in Fig. 4 shows the result of a normal student. Because he is not addicted now, but has only weak factors for the habitual substance problem, the report gives the factors which have possibility for him to be addicted. In this case, the will of refusal is major weak point, and next, antisocial characteristics, the belief, uneasiness and characteristics are the problem. Especially, because he has antisocial and uneasy psychological problem, our system leads him to psychological recovery room.

Fig. 5 Simulation result for an addicted student

The case in Fig. 5 shows the result of a serious addicted student. Because he is weak for all factors, the report gives the 5 top serious factors to fall into temptation of habitual substance disorder. In this case, the will of refusal is major weak point, and next, school score,

parent's habitual substance disorder, the belief, and negative self-consciousness are the problem. Especially, because he has serious problems, our system leads him to suspension class room.

Because previous factor analysis for habitual substance disorder in adolescents include only subset of the factors: for examples, paper [12] only have factors such as father's smoking, mother's smoking, friend's smoking, and level of stress. Therefore, we only show our simulations results.

4. Conclusion

Habitual substance disorder such as smoking, drinking and drug is very important issue. Online site is cost-effective method to understand and analyze the individual health problem. And it is good accessibility. Therefore, we design the knowledge-based system to diagnose and analyze the habitual substance disorder. It is virtual expert to help each adolescent to overcome the problem. We do case-by-case simulation, and then explain the result in this paper.

The main point of this study is man-to-man analysis of habitual substance disorder in adolescents. And then it provides customized solution to solve the problem. The further works are to make graphical report for the diagnosis history.

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Appendix

Only several part among 14 factors are showed here.

Part 1. Belief for habitual substance disorder

- Life is boring without drinking/smoking/drug.
- Drinking/smoking/drug makes thinking and working easy.
- I cannot work well without drinking/smoking/drug.
- I do drinking/smoking/drug to overcome life's pain.
- I'm not ready to stop drinking/smoking/drug.
- I do drinking/smoking/drug because of the desire for it.
- Although I stop drinking/smoking/drug, my life will not be changed.
- Anger quieted down with drinking/smoking/drug.
- If no drinking/smoking/drug, life will be depressive.
- There is no reason to stop drinking/smoking/drug.
- I'm weak-willed to stop drinking/smoking/drug.
- I can make friends with drinking/smoking/drug.
- Drinking/smoking/drug is not a problem to me.
- If I stop drinking/smoking/drug , I want to do it.
- I do drinking/smoking/drug because of friends or other people.
- The reason of drinking/smoking/drug is inheritance.
- I feel comfortable with drinking/smoking/drug.
- I think that the person having drinking/smoking/drug problem is a bad or inferior person.
- Without drinking/smoking/drug, I cannot control uneasiness.

Part 2. Will of refusal for addictions to smoking

- When having a meeting with friends, I want to smoke.
- When wake up, I want to smoke.
- When uneasy or stressful, I want to smoke.
- When talking and playing with friends, I want to smoke.
- When refreshing myself, I want to smoke.
- When I'm angry, I want to smoke.
- When intimate friends are smoking, I want to smoke.
- When I recognize I didn't smoke, I want to smoke.
- When work makes me break down, I want to smoke.

Part 3. Home environment

- My parents know my best friends well.
- My parents try to understand me when conversation.
- My parents want to know the reason when I'm anxious.
- My parents always give an answer about my question.
- My parents say "Don't worry", "Good job" or "Cheer up" frequently.
- My parents know for me how to study well.
- My parents scold me for deal things in home without permission.
- My parents force me to study hard when meeting friends for a while.
- My parents allow no mistake.
- My parents scold me when I don't follow their instructions in spite of a little thing.
- My parents force me to follow their directions.
- My parents don't approve anything if it cannot catch their fancy, although I do something right.
- I want to live with other family.
- I do interesting things with my parents.
- Our home and family is wonderful.
- Our family is concordant.
- My parents give fair treatment.
- My family considers mutual feeling.
- My family is better then other family.
- I'm happy with my family.
- I like the time with my parents.
- I like my home and family.

Part 4. Antisocial characteristic

- I show temper in spite of a minor thing.
- I cannot calm down because of uncontrollable anger.
- I fight like a tiger.
- I fight despite an unimportant thing.
- I have done a fist fight and knocked a thing to pieces
- I steams easily and tend to become emotional.
- I do any action immediately.
- Making long-term friend is difficult to me.
- I'm antisocial and self-centered.
- When I'm upset, I have to my anger out.
- I have no confidence, and cannot work with certainty.