

A Methodology of Measuring Degree of Contextual Subjective Well-Being Using Affective Predicates for Mental Health Aware Service

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The contextual subjective well-being (SWB) of context-aware system users can be very helpful in recommending relevant mental health services, especially for those who struggle with mental illness due to a metabolic syndrome or melancholia. Self-surveying measuring or auto-sensing methods have been suggested to monitor users' SWB. However, self-surveying measuring method is not inappropriate for a context-aware service due to requesting personal data in a manual and hence obtrusive manner. Moreover, auto-sensing methods still suffer from accuracy problem to be applied in mental health services. Hence, the purpose of this paper is to propose a contextual SWB estimation method to estimate the user's mental health in unobtrusive and accurate manners. This method is timely in that it acquires context data from the user's literal responses, which expose their temporal feeling. In particular, we developed a measuring method based on exposed feeling verbs and degree adverbs in chat and other text-based communications which show anger or negative feelings. Based on the proposed contextual SWB degree estimation method, we developed an idea of well-being life care recommendation. From the experiment with actual drivers, we demonstrated that the proposed method accurately estimate the user's degree of negative feelings even though it does not require a self-survey.

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1. Introduction

One of the biggest opportunities to apply

context-aware intelligent services in actual practice lies in e-services that are targeted to preserve well-being or mental health. People who suffer

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from a range of mental illnesses that might be due various stressful situations need consistent and relevant monitoring for all situations. In this regard, a success factor of context-aware services for such people depends on how well the individuals' mental health can be accurately and promptly estimated, yet at the same time how the service can improve its natural interface for improved convenience and ease of use. Ultimately the valuable service should help improving the customer's happiness or well-being state.

However, since the well-being state varies according to the users and situations confronted, it is accepted as a subjective-cognitive element, so it is called Subjective Well-Being (SWB) (Diener and Ryan, 2009). When we say valuable service, this means that it increases the user's SWB. Actually measuring the degree of SWB in a relative manner is very important for the successful service.

Conventionally, this self-reporting method has been widely accepted in the field of psychology to measure a state of well-being. This method surveys SWB-related items and explains overall SWB with set of items. The representative methods are Anchoring Striving Scale (Cantril's, 1965), Sixty-second happiness measure (Fordyce, 1977), Positive Affect Negative Affect Schedule (PANAS; Watson, 1988), Satisfaction With Life Scale (SWLS; Diener, et al., 1985).

However, self-reporting, self-measurement methods have some drawbacks vis-à-vis regular use for context-aware services. First, they are "big picture," measuring in individual's larger, whole

life, well-being state. SWB states are always consistent; rather, they are changeable according to specific situations in which users find themselves. For example, even though an individual generally lives a satisfactory life, he or she might not retain those same satisfaction level being, for example, stuck in heavy traffic. An individual's overall well-being, and his or her contextual well-being, can easily be two different things. Secondly, since self-report measuring per se is affected by the person's feeling which can change dynamically, measuring SWB at one time is not sufficient for completely and accurately estimating one's general state. Therefore, the general well-being state should be measured many times (Diener, 2009). Third, since conventional self-reporting method is conducted with a context-free questionnaire, it is difficult to connect or estimate the results to a situation-dependent state of well-being. Last, it would be very burdensome to the point of being fruitless for users to answer dozens of questions whenever they request any context-aware services.

With respect to this concern, a medical approach might be considered as an alternative way of self-report measuring. Facial color, tongue color or heart beat acquired from bio-sensors can provide a person's well-being state in a timely manner. However, to use this method, the user would need to wear the sensors or sensor-embedded devices at any time-an idea that most would find unnatural.

In related areas, researchers have been examining the relationship between negative feelings and stress. For example, McLinton and

Dollard (2010) proved a relationship in a Japanese context between anger and stress. They used a Driving Anger Scale (DAS) to measure anger, as DAS has been widely used to measure anger that is exposed while driving. Deffenbacher et al. (1994) revealed DAS is meaningful for measuring an individual's traits and this data can also be helpful for identifying health problem. DAS consists of 14 driving situations: hostile action, police emergence, slow driving, unscrupulous action, aggressive driving etc. Participants respond as to their subjective degree of anger in situations by scoring from 1 to 5 (Yasak and Esiyok, 2009). Other than DAS, Multidimensional Anger Scale (MAS) is used to measure anger with multidimensional concepts. State Anger Scale (SAS), Trait Anger Scale (TAS) and State-Trait Anger Expression Inventory are other candidates to estimate degrees of anger (Deffenbacher et al., 2003). However, they all have weakness to be used in context-aware services simply because they use survey techniques. There should be a more automated and timely measuring method for contextual SWB to provide situated services. To address this concern, we aim to use context data which can be naturally gathered and hence does not require the user's additional efforts.

One promising user context for naturally measuring contextual SWB is what a user says or writes, which includes feeling predicates. It is well known that SWB consists of three elements : positive feelings, negative feelings, and life satisfaction. Life satisfaction measures an individual's overall satisfaction with his or her life, and is

measured by the Satisfaction With Life Satisfaction (SWLS) method. Many studies have supported a hypothesis that life satisfaction measured by SWLS has a positive relation to positive feelings (Diener et al., 1985; Lucas et al., 1996; Schimmack et al., 2002; Suh et al., 1996). The opposite is also true; anxiety and depression are related to psychological stress and hence have a negative relation to positive feeling (Schimmack et al., 2004; Van Hemert et al., 2002; Wilkinson, 1998). These imply that we can estimate SWB if we can recognize symbols that express a positive or negative feeling even though we do not rely on a questionnaire method like SWLS. Sentences written by a user that include feeling verbs would be a naturally accessible factor to conjecture with the user's dynamic feeling. However, few context-aware computing studies to date quantify the degree of affect to each feeling verb and then apply the quantified results to estimate one's temporal affect to estimate subjective well-being.

Hence, the purpose of this paper is to propose a method to acquire higher abstract level context, SWB and degree of negative affect, from the user's text. To do so, first of all, we will focus on estimating the levels of anger based on feeling predicate which consists of selecting a feeling verb and a degree adverb. Then, based on the estimated level of anger, we will propose a method to measure the degree of SWB, as well as negative affect. In addition to a feeling verb, a degree adverb will also be considered to adjust the degree of anger of corresponding feeling verbs. The method provides the user with response diversity

by taking into consideration the degree of anger of nearly 100 feeling verbs, which is much more than the number of verbs considered in the previous studies. Improved response diversity will eventually contribute to enhance user satisfaction by allowing the users to expose their feeling more elaborately.

The remainder of this paper is organized as follows. In chapter 2, we described previous works on SWB and feeling verbs. Chapter 3 introduces the outline and measuring steps of the proposed method. To show the feasibility of the ideas proposed in this paper, implementation and experiment are delineated in chapter 4. Finally, in chapter 5, we conclude with a discussion and further research issues.

2. Related Works

2.1 Subjective Well-Being

In positive psychology, the concept of well-being was divided into Subjective Well-Being (SWB); and Psychological Well-Being (PWB), formulated by Ryff. Ryff and Keyes (1995) argued that it is difficult to measure PWB with a single standard, so they developed a new measuring model that uses multi-criteria : autonomy, personal growth, self-acceptance, purpose of life, and the ability to have positive relations with others. It is known that higher level of PWB can aid a more effective adaptation to one's life changes and has a meaningful relation with emotional and physical health (Ryff and Singer, 1998).

Even though Ryff's model is strong in terms of reliability and accuracy, it is limited in that it needs a number of survey items. In particular, estimating a temporal well-being would require users to answer too many questions for every different situation, rendering the model less usable. One way to overcome this limitation is to consider a temporal PWB measuring method with an emotional state, which can be collected from what the user says or writes. Since emotional state is one of the variables to predict PWB (Urry et al., 2004), we can use it to measure the user's PWB. Specific measuring methods can be used, such as Positive Affect and Negative Affect Scales (PANAS), which measures positive and negative feeling. PANAS is already developed and widely adopted to many legacy systems (Watson et al., 1988).

Compared to PWB, SWB is more a typical bottom-up theory : it estimates the user's degree of well-being based on personal and situational stimulus from individual experience. On the other hand, PWB has more focus on an overall, consistent state than the fluctuation of individual situations. Even though SWB still has not been successfully theorized as PWB at the mercy of Ryff, SWB is more practical because it is measured with universally acquired human feelings.

According to Diener et al.'s study (1997), SWB consists of cognitive factors (e.g. life satisfaction) and affective factors. As for cognitive factors, items measuring life satisfaction such as SWLS is already available. Moreover, the items can be adjusted to measure a more specific cur-

rent well-being rather than an overall well-being (Pavot and Diener 1993; Simsek, 2009). As for affective factors, positive emotion is expressed as cheerful, in good spirits, extremely happy, calm and peaceful, satisfied, full of life; phrases used to describe negative emotions include so sad nothing could cheer you up, nervous, restless or fidgety, hopeless, worthless. These expressions on positive affect and negative affect are well conceptualized regardless of cultural difference (Zhang et al., 2009).

Nevertheless, current PWB and SWB models are not ready to be directly used to estimate current well-being, which is useful for recommending context-aware services. A context-aware service could ideally understand users' emotional states in their current context. An overall life satisfaction index based on legacy PWB or SWB would not be very useful. PWB and SWB are more limited because they use a very limited number of feeling verbs to estimate the degree of well-being. This would be less of an issue if affective states were collected from a well-structured mechanism such as questionnaire and structured interview. However, under actual situations, the users use far more expressions. Hence, degrees of feeling for more feeling verbs should be quantified to gather the affective states.

2.2 Feeling Verbs

Since we initiated a healthcare service development project in Korea, yet conventional anger measurement methods were based on English,

it was necessary to research Korean language studies to measure degrees of anger embedded in Korean feeling verbs.

Kim (2005) noted that feeling states occur from stimulations regardless of conscious intention; a process that is very subjective to the individual's internal experience. Even identifying what feeling verbs are and are not is not simple-which leads us to attempt to verify feeling verbs through surveys as the preliminary efforts to estimate feeling state of a certain feeling verb.

There have been several efforts to estimate feeling states in Korean feeling verbs. Ahn et al. (1993) surveyed 669 persons; 85% the persons agreed that 224 verbs are feeling verbs from 3,582 candidate verbs. With 60% agreement level, Park (2001) chose 434 feeling verbs from 52,275 candidate verbs. Shaver et al. (1987) chose 135 feeling verbs from 213 candidate verbs. Kim (2004) integrated the above findings with Kim (2000) and Kim (2002)'s studies, and then made list of 494 feeling verbs which are verified by self-made verification sentence patterns.

However, several concerns and conflicts arose regarding classification of a feeling state. Kim (2004) classified feeling verbs into cause-centered and target-centered verbs. If a verb's concern is caused by a certain occurrence, we can say the verb belongs to cause-centeredness. On the other hand, the verb is target-centeredness when it is used to express the subjective feelings to a target. Lee (2006) classified feeling verbs as expressing an internal state and an external response. The words happy, scary and envious de-

<Table 1> Examples of Degree of Feeling

Lower	Average	Higher
끌리다(kl-li-da, attracted)	좋아하다(jo-a-ha-da, like)	사랑하다(sa-rang-ha-da, love)
화나다(hwa-na-da, annoyed)	분노하다(bun-no-ha-da, angry)	노발대발하다(no-bal-dae-bal-ha-da, enraged)
두렵다(du-ryop-da, scared)	겁나다(geop-na-da, afraid)	혼비백산하다(hon-bi-baek-san-ha-da, terrified)

scribe a speaker's psychological state subjectively so they belongs to the former, and the words rejoice, fear and envy belong to the latter because they describe overt feelings via the Korean -eoha-da morpheme. Shaver et al. (1987) divided the results of their survey into 6 major groups and 25 sub groups.

One of the main characteristics of feeling verbs in many languages is that they have a certain degree of feeling (Kim, 1979; Kim, 2004; Kim, 2005). For example, Korean feeling verbs have a degree dimension as shown in <Table 1>.

In the same row of <Table 1>, all verbs have similar meaning, but left verbs' degrees are weaker than right ones. Therefore, the selected verbs express the speaker's feeling in a different degree. When a speaker wants to use feeling verb, a proper verb is selected by the speaker to express properly his intended degree of feeling.

3. Methodology of Estimating Subjective Well-Being with Feeling Verbs and Degree adverb

3.1 Overall Process

The overall process for estimating contextual SWB is shown in <Figure 1>. First, when

a feeling predicate is derived from the environment (i.e., from instant messaging or e-mail systems), the predicate is parsed into feeling verb and degree adverb. Formally, context information (C), acquired from context-aware functionality, consists of feeling predicate (P) and user profile (U) as (1).

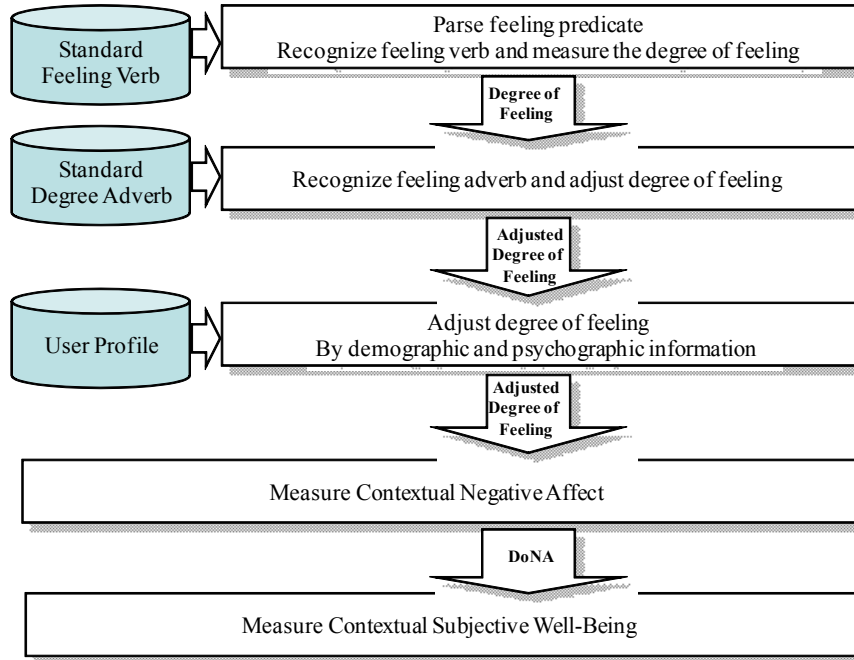
$$C = \langle P, U \rangle \quad (1)$$

A feeling predicate contains a feeling verb and a degree adverb. The specific feeling verb (v) and degree adverb (a) belong to a set of standard feeling verbs (V) and standard degree adverbs (A), respectively. Hence, $v \in V, a \in A$.

$$P = \{v, a\} \quad (2)$$

The next step of the process is to measure the degree of feeling of the recognized feeling verb. At this time, the measuring knowledge stored in standard feeling verb repository can be referred.

The measured degree of feeling can be adjusted by degree adverb and/or personal profile, which are stored in a degree adverb repository and personal profile repository, respectively. According to the related works, we consider demo-



<Figure 1> Overall Process of Estimating Contextual SWB

graphic data such as ages, employment and income level, as well as psychographic information such as neuroticism. For the adjustment of degree of feeling with user profile, a regression model is established from survey data.

Using the degree of feeling, we then derive a contextual negative affect and contextual SWB. We know that SWB is affected by positive and negative feelings and overall life satisfaction (Keyes et al., 2002). Originally SWB is determined as : (life satisfaction + degree of positive feeling - degree of negative feeling) (Elliot, 1999). Since we focus on degree of negative feeling's partial effect on SWB, we regard (life satisfaction + degree of positive feeling) equaling the constant value, K.

$$DoSWB = K - DoNA \quad (3)$$

Where Degree of Negative Affect(DoNA), which is measured by (4).

$$DoNA = f_4(u_1, u_2, \dots, u_N, f_3(f_2(a), f_1(v))) \quad (4)$$

$f_1(v)$ is a function that calculates the specific degree of a feeling verb. This would correspond to specific word's degree of feeling, and expressing feeling verb's traits and corresponding relations. As for V, a set of feeling verbs, conventional SWB's self-describing adjectives are widely used. In particular, Brunstein's study identified nine adjectives such as happy, active, pleased, joyful etc., which are used for positive

feeling or mood, and 12 adjectives such as helpless, nervous, annoyed, tense, irritable etc., which are used to estimate the degree of negative feeling (Brunstein 1993). The reason why just a small number of selected words are considered is due to lack of linguistic study. In this paper, we take an ample number of words for more accurate measurement.

In the meanwhile, $f_3(f_2(a), f_1(v))$ can be seen as an adjusted degree of feeling made by degree adverb and that by feeling verb. Finally, $f_4(u_1, u_2, \dots, u_N, f_3(f_2(a), f_1(v)))$ is a function of degree of negative affect (DoNA). It means that degree of feeling, $f_3(f_2(a), f_1(v))$, is re-adjusted by N attributes of user's profile to get DoNA.

Finally, the differentiation of Degree of Subjective Well-Being (DoSWB) is set as (5) :

$$\Delta DoSWB = f_0(\Delta DoNA) \quad (5)$$

where f_0 indicates a function of Degree of Negative Affect (DoNA).

3.2. Measurement of degree of feeling by feeling verbs

To get the degree of affect for 99 selected feeling verbs, we used a survey. The verbs that describe anger were classified with six feeling categories (Choi, 2008). The classification conducted by Kim (2004)'s 494 feeling verbs and Shaver et al. (1987)'s six meaning groups: love, joy, surprise, anger, sadness, and fear. Hostile or

inappropriate messages are known as a main reason of conveying or inciting anger (Doob and Gross 1968; Potter et al., 1995). If we know the degree of feeling for the anger-related words, we will understand the current degree of anger of the speaker. A widely accepted way to obtain the anger-related words is to embed parser into instant messaging or e-mail systems.

We considered 99 anger verbs. Initially, 121 subjects who live in Korea applied for the experiment. Since we will compare our method with DAS for measuring a driver's anger while he is driving, we collected subjects who have their own driver's license and have actual experience of driving. Among those, one subject who did not answer the questions was excluded in the experiment. Finally, 120 subjects are selected as valid sample. The socio-economic profiles are described in <Table 2>.

<Table 2> Participants' Socio-economic Profiles

Attribute	Values	Frequency	Percentile
Income	Lower	30	25.0%
	Average	56	46.7%
	Above average	18	15.0%
	Higher	5	2.5%
	No response	11	10.8%
Employed	Employed	81	67.5%
	Unemployed	36	30.0%
	No response	3	2.5%
Ages	20's	53	44.2%
	30's	46	38.3%
	40's	11	9.2%
	50's	4	3.3%
	60's or more	6	5.0%
No response	0	0.0%	

The data was collected from December 2009 to January 2010. The subjects were asked to answer the degree of feeling that they perceive when they recognize the feeling verbs. Each feeling verb is scored from 0 to 10. For example, if a participant has no feeling of anger when they see hwanada (angry) he will score the verb as 0. If they have the highest feeling of anger with same word, then he was asked to report 10. As a result, we acquired the average degree of anger for all considering feeling verbs as shown in Appendix A. The scores range from 1.0 to 8.1. Highest scored verbs were 역겹다(yeok-geop-da, disgusting), 증오하다(jeong-o-ha-da, loathing), and 혐오하다(hyeom-o-ha-da, loathing), while 동경하다(tong-gyeong-ha-da, longing), 부럽다(bu-rup-da, envious) and 부러워하다(bu-reo-weo-ha-da, envious) scored lowest.

In a real conversation setting, since there are many verbs which are not surveyed here, so we tried to find some morphological traits to conjecture the feeling degree of unexpected words. First, many highest scored verbs have another anger part in the word : anger words' degrees of feeling are increased by the other anger morphemes. This feature appears in the words of degree higher than 6.0 such as 경멸하다(kyeong-myeol-ha-da, 7scoren), and 격분하다(kyeok-bun-ha-da, very furious). 경(kyeong), 멸(myeol) in the first word and 격(kyeok), 분(bun) in the second word separately express anger feeling. 분통터지다(bun-ong-eo-ji-da, enraged) and 울화치밀다(ul-hwa-chi-mil-da, resentful) are also increasing degree of feeling more by taking a anger subject-anger predicate

structure. We know this by inserting subject case marker -이(i)/가(ka) in the middle of the words; as like 분통이 터지다(bun-tong i teo-ji-da), 울화가 치밀다(ul-hwa ka chi-mil-da). The subjects and predicates are relevant with anger feeling individually. These structures take 55% of above 6.0 degree verbs.

Second, intermediately scored verbs such as 화나다(hwa-na-da, angry), 성질나다(sung-jil-na-da, bad temper) and 밉다(mip-da, hateful) have homogeneous single feeling noun like 화(hwa, anger), 성질(sung-jil, temper) and 미움(mi-um, hate) per se. Hence, if we know the feeling degree of a noun or just find the single feeling noun in the unexpected word, we can guess that the rough score of the word as 4.0~5.9 score.

Third, most feeling verbs with a lower score, below 4.0 degree, reflect a weak feeling of anger. They tend to indirectly express anger. The anger meaning of 지겹다(ji-kyeop-da, boring), 지루하다(ji-ru-ha-da, boring), 고리타분하다(go-ri-ta-bun-ha-da, stuffy), 물리다(mul-li-da, fed up), 식상하다(sik-sang-ha-da, fed up), 시시하다(si-si-ha-da, trivial), 시들하다(si-dul-ha-da, indisposed) and 심드렁하다(sim-du-rung-ha-da, dragged) just come from speaker's repeated experiences. And the angry meaning of 시기하다(si-gi-ha-da, jealous), 시샘하다(si-saem-ha-da, jealous), 토라지다(to-ra-ji-da, sulky), 뿔로통하다(pyoro-tong-ha-da, sulky) and 셀쪽하다(sael-juk-ha-da, sulky) may come from the speaker's perspective or emotional state. Hence, they are not effective to show enthusiastic anger. Meanwhile, the verbs of lower degree of feeling such as 남

부럽다(nam-bu-rup-da, envious), 부러워하다(bu-reo-weo-ha-da, envious), 부럽다(bu-rup-da, envious) and 동경하다(tong-gyeong-ha-da, longing) are also just expressing a not-angry feeling to other person.

In short, a degree of feeling can be divided into three categories : scored high, medium and low. Degree 6.0 or more feeling verbs belong to high category, which means that they express relatively high feeling with the feature that is special in terms of structure. Degree between 4.0 and 5.9 verbs belong to medium category : they express basic anger level with word itself anger meaning. Finally, below the degree 4.0 verbs belong to low category. They just express uncomfortable feeling with some exceptions. These categories are useful to recognize the degree of unexpected feeling words.

3.3 Adjusting Degree of Feeling by Degree Adverb

Sometimes the added morphemes act like degree adverbs. These morphological structures provide a basis as to how the more complicated messages can be recognized. For example, we recognize a higher degree of anger in sentence when an anger verb is used repeatedly. Or we can morphologically explain the sentences which already have a higher anger feeling when the sentence also includes a degree adverb. Hence, degree of feeling is the product of an adverb's intensity, and a degree of feeling of feeling verb is valid in this regard. The degree of feeling of feeling verb can be modified by the intensity of

degree adverb as (6).

$$f_3(f_2(a), f_1(v)) = f_2(a) \times f_1(v) \quad (6)$$

Meanwhile, Hong (2002) theoretically classified Korean degree adverbs into four grades. Grade one adverbs are 무척(mu-chuk, very much), 매우(mae-woo, extremely), 아주(a-joo, exceedingly), 몹시(mop-si, terribly) and 너무(neo-moo, overly). They are called as maximizers. Grade two adverbs, called booster, include 심히(sim-hi, quite), 꽤(puk, very), 썩(suk, really), 참(cham, truly) and 대단히(dae-dan-hi, greatly). Grade three adverbs are 꽤(kwoe, pretty), 제법(je-pup, fairly) and so on and they are called as compromisers. Finally, grade four adverbs, called as diminishers, include 좀(jom, a little) and 조금

<Table 3> The Grade and Strength of Degree Adverbs ($f_2(a)$)

Grade	Degree Adverbs	Strength Score
One	Muchuk(very much)	2.0
	Maewoo(extremely)	
	Ajoo(exceedingly)	
	Mopsi(terribly)	
	Neomoo(overly)	
Two	Simhi(quite)	1.6
	Puk(very)	
	Suk(really)	
	Cham(truly)	
	Daedanhi(greatly)	
Three	Kwoe(pretty)	1.2
	Jebup(fairly)	
Four	Jom(a little)	0.5
	Jogum(a bit)	

(jo-gum, a bit). Then we give intensity score to the four grades as shown in <Table 3>.

When a user expresses a feeling verb only, the score will be only 1. When the above degree adverbs are also used the score will be changed. For example, when a speaker expresses negative feeling using only by 화나다(hwa-na-da, angry) the feeling score will be 1.0. However, if 조금(jo-gum, a bit) is used, the adjusted degree of negative feeling will be 0.5(= 1.0×0.5). Similarly, if 심히(sim-hi, quite) is used the degree will be 1.6 (= 1.0×1.6). If 아주(a-joo, exceedingly) is used as intensity, then the degree will be set to 2.0 (= 1.0×2.0).

3.4 Adjusting Subjective well-being (SWB) with personal profile

The individual's personality and demographical traits affects the individual's subjective well-being (SWB) in several ways. First, in general as a relative income level increases, SWB also tends to increase. However, the marginal increase decreases just like the principle of marginal utility (Diener et al., 2009; Frey and Stutzer, 2002). Second, unemployment clearly negatively affects SWB (Clark, 2009). Thirdly, as a person get older, SWB also tends to increase or at least does not decrease (Herzog and Rodgers, 1981; Horley and Lavery, 1995). Fourthly, social activity and human relations affect SWB in a positive manner (Diener and Biswas-Diener, 2008). These phenomena explain why powerful social interactions like marriage increases SWB (Helliwell et al., 2009).

Meanwhile, personality has been regarded as a factor that affects SWB; for example, if someone has an extrovert personality, positive feelings are also expressed more (Lucas and Fujita, 2000). Finally, neuroticism is connected with negative feeling (Fujita, 1991).

When we consider the above findings, SWB will potentially be more accurately estimated by feeling verbs and degree adverbs. The contextual degree of SWB can be adjusted by one's personality and demographical traits.

3.5 Estimation of Contextual SWB

As supposed earlier, we assume that the degree of subjective well-being (DoSWB) is a function of the degree of negative affect (DoNA) as below. And we can easily assume that $\Delta DoNA$ is inversely proportional to $\Delta DoSWB$. In this paper, we developed the following formula (7) using input from Busseri's research (Busseri et al., 2007).

$$\Delta DoSWB = -0.28 \times \Delta DoNA \quad (7)$$

Finally, when contextual SWB is estimated, a proper service for well-being can be chosen and recommended to return user's mental health to the normal SWB state.

4. Experiment

4.1 Design

The experiment aims to examine how

well the proposed contextual SWB estimation method, based on affective predicates, is valid in actual situations. To do so, the results from the Driving Anger Scale (DAS), which has been widely used to estimate the degree of negative feeling and eventually SWB, and those from the proposed method will be compared to observe if the two result sets are statistically interrelated. If the two sets are interrelated, then we could conclude that DAS can be replaced with the proposed method to estimate SWB. This is useful for the computer-based systems to acquire the user's contextual SWB in an automated manner, and hence minimize the user's concerns for any interruptions such as requesting answers to some questions in DAS. Moreover, the selected feeling verbs can be used as representative words to estimate the speaker's or writer's feelings.

We used a survey to collect sample data from the subjects as described above in <Table 2>. To estimate the participant's anger experience, all items of DAS, feeling verbs, and degree adverbs are shown to the participants. We then referred to Deffenbacher et al's driving scenarios to answer the questions (Deffenbacher et al., 2003). We also posed questions regarding perception constructs, neuroticism, and perceived satisfaction vis-à-vis human relationships, using a 5 Likert scale. This is because we want to examine how neuroticism and perceived satisfaction on human relationships affect negative feelings as earlier studies suggested.

4.2 Results

We compared the degree of negative affection measured by the Driving Anger Expression Inventory (DAX) of the DAS model, and that measured by feeling verbs and degree adverbs according to the driving scenarios. We then examined to what extent the two degrees of negative affection are interrelated. If the correlation was significantly high, then $\Delta DoNA$ and $\Delta DoSWB$ can be estimated only with simple user profile and affective predicate, not with lots of questions in DAX.

As a result, <Table 4> shows how the considering variables are correlated : unexpectedly, income, employment and ages were not statistically related to DAX. This is likely due to the fact that the earlier studies asked participants regarding a more long-term DAX. This is totally different setting because this study focused on a certain situation. Situational anger might not affected by income, employment and ages. Secondly, earlier studies have reported that income, employment and ages have something to do with SWB not directly with DAS or DAX. Hence, actually the relationships between DAX and the three constructs, income, employment and ages have not been examined.

Relationships and neuroticism, however, do have a significant correlation to DAX; however, the direction is different: relationships are negatively correlated to DAX (-0.187), while neuroticism has a positive correlation (0.343).

This could be attributed to a state of having stronger social relationships may make an individual less likely express negative emotions as anger to others. On the other hand, since the individuals of higher neuroticism are more likely than average to experience anger, they respond poorly to environmental stresses such as troubles while driving. This opposite correlation is supported by the result of the correlation between social relationships and neuroticism (-0.387) as shown in <Table 4>.

Anger estimated by the proposed method, as expected, is positively correlated to DAX (0.391). Considering the correlation values which are more than 0.3 have been regarded as substantially meaningful in social studies, anger can be regarded as critical construct to illustrate DAX.

As for anger construct, constructs other than DAX were not significant. This gives a useful implication : the relationship between DAX

and anger may not be mediated by other conditions and hence if only the users reveal his anger in a valid manner, he may not need to disclose any further personal data such as income and ages.

We also conducted a step-wise regression to estimate DAX with anger and the other variables. As a result, as shown in <Table 5>, anger and neuroticism were selected as significant determinants with 0.447 expression power. If personal psychographic data are not available due to privacy concerns or convenience issues, then we could choose model 1, even though its expression power (0.367) is less accurate than the other model.

To summarize, we developed an SWB estimating method that does not require a self-survey (such as DAX where the users have to answer questions manually). Instead, we developed a context-aware service that automatically collects context data as affective predicates and then esti-

<Table 4> Mean, Standard Deviation and Correlation(n = 120)

	DAX	Income	Employment	Ages	Social relationship	Neuroticism	Anger	Mean	Standard deviation
DAX	1							1.319	1.793
Income	0.050	1						2.367	1.413
Employment	0.034	0.344	1					1.350	0.529
Ages	-0.041	0.086	-0.017	1				33.9	10.008
Social relationship	-0.187	0.080	0.031	-0.023	1			3.683	0.661
Neuroticism	0.343	0.207	0.161	-0.033	-0.387	1		2.500	0.789
Anger	0.367	0.226	0.029	-0.129	0.034	0.263	1	7.192	4.272

Note : Boldfaces are significant at p < 0.01.

<Table 5> Results of regression analysis(n = 120)

		DAX		
		1	2	BEST
		beta	beta	beta
Intersection		0.212	0.2559	-1.088*
Anger		0.154***	0.132***	0.125***
Control variables	Income		-0.003	
	Employment		-0.020	
	Ages		0.001	
	Social relationship		-0.306	
	Neuroticism		0.499*	0.604**
Pearson R		0.367	0.460	0.447

Note : * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

mates higher level abstract contexts such as anger and SWB. Some may argue that the correlation value (Pearson R) 0.447 may not satisfactory to illustrate DAX and hence SWB. However, what we actually need is not the exact score of SWB, but the score change. No matter what the level of SWB is, the context-aware service will be active and work only if the level goes down.

4.3 Estimating a Change Volume of Subjective Well-Being Using Anger Score

Once a degree of anger is estimated, then formula (4) about negative affect ($DoNA$) is instantiated as (8), based on the results in Table 5. The coefficient of Anger variable, 0.125, is applied to (6), $f_3(f_2(a), f_1(v))$. Moreover, among user profile as control variables (u_1 u_5), only u_5

is left in (8).

$$DoNA = z - 1.088 + 0.125f_3(f_2(a), f_1(v)) \quad (8) \\ + 0.604u_5$$

Based on the result from (8), a contextual SWB is derived as shown in (7). $f_3(f_2(a), f_1(v))$ indicates the degree of anger, which is function of intensity of degree adverb ($f_2(a)$) and the degree of feeling verb ($f_1(v)$). u_5 is the fifth control variable, neuroticism, which ranges from 1 to 5.

We developed a prototype system, emoChat, using Java. emoChat is based on an open source chatting program dispatched by Planet-Source-Code.com. On top of the source code, a database interface module and contextual SWB estimation module are newly developed (El, 2009). emoChat consists of a server program and a client program.

The server program initially requests demographic data and some psychographic data from the user, if he or she is willing to share that information. Then the system only request neuroticism, which is the only control variable in the accepted regression model. Other than neuroticism, some demographic data, inquiry, income, employment, ages and social relationship can be extensively asked. However, the user may ignore the requests due to privacy concerns.

After entering the data values, a driving scenario, randomly selected from the 49 scenarios in DAS database, is shown on the user's display. For example, "I'm driving down the road at a regular speed, when a driver comes up fast behind me, is tailgating me, and starts to flash his high beams." The system asks the user to imagine being in that scenario, and then to write down his or her feelings with an affective predicates : e.g. very angry, annoyed, a little bit uncomfortable, etc. Since emoChat system can recognize 99 feeling verbs and 15 degree adverbs, the user can use 1,485 expressions by combining the verbs and adverbs. This recognizing capability enables much more abundant expressions than legacy SWB estimation techniques, which use 10 or more expressions. The next release of emoChat will be added on Instance Messaging system or smart phones as application.

5. Conclusion

As mobile devices' computing power grows,

and smart phones in particular, context-aware services become more feasible. One of the biggest opportunities for context-aware services lies in health or life-care services. In light of this, individuals' SWB is a crucial measure to help make decisions regarding which care services could be provided to the users in a timely and relevant manner. Being able to accurately and transparently estimate the user's SWB automatically or at least naturally is needed. However, conventional self-survey techniques are ineffective because the techniques require users' manual input and hence will not be perceived as convenient. Meanwhile, conventional sensors which acquire physical context data are likewise insufficient for recognizing the user's perception such as SWB.

Hence, we propose a novel subjective well-being estimation method using affective predicates which are revealed in the user's chat or e-mail system. To do so, linguistic knowledge is applied to quantifying the affect level of each predicate, which consists of a feeling verb and a degree adverb. In this paper, we focused on anger. 99 feeling verbs and 15 degree adverbs are evaluated by the domain experts; a method is then developed to estimate the change of temporal SWB based on those affective predicates.

To examine the performance of the method, we compared a Driving Anger Scale (DAS) using Driving Anger Expression Inventory (DAX) because it has been widely accepted techniques to estimate anger. According to the correlation test and regression analysis, we found that

the anger score from our method and that from DAX has statistically significant relationships. This means surveying with DAS can be replaced by the proposed method, which is the main contribution of this paper.

The second contribution of this paper is the interdisciplinary effort : subjective well-being theories in positive psychology and feeling verb research in linguistics are applied to perception-aware computing. Since one of the critical success factors of the context-aware systems is to recognize higher level context in accurate and natural manner, inviting social science and humanities will likely contribute to more meaningful outcomes.

The proposed method is now being applied to implement well-being life care service based on smart phones. The well-being life care service will be used in any caring services such as everyday life-care, health-care and solitary-care. In particular, we will develop the context-aware anger estimation and recommendation service for smart cars which contain voice recognition functionality and our emoChat system. Other than this, we are going to extend affective elements other than anger in estimating SWB.

References

- Ahn, S. H., S. H. Lee and O. S. Kwon, "Activation Dimension : A Mirage in the Affective Space?" *The Korean Journal of Social and Personality Psychology*, Vol.7, No.1(1993), 107~123.
- Choi, S. J., "The Type and Character of Feeling Verb", *Journal of the Society of Korean Language and Literature*, Vol.58(2008), 127~159.
- Balkaya, F., "Cok Boyutlu Ofke Envanteri'nin gelistirilmesi ve bazi semptom gruplarindaki etkisi (Development of Multidimensional Anger Scale and effects on some symptoms)", Unpublished manuscript, Thesis, (2001).
- Brunstein, J. C., "Personal goals and subjective well-being : A longitudinal study", *Journal of Personality and Social Psychology*, Vol. 65(1993), 1061~1070.
- Busseri, M., S. Sadava and N. DeCourville, "A Hybrid Model for Research on Subjective Well-being : Examining Common-and Component-specific Sources of Variance in Life Satisfaction, Positive Affect, and Negative Affect", *Social Indicators Research*, Vol.83, No.3(2007), 413~445.
- Cantril, H., *The pattern of human concerns*, New Brunswick, NJ : Rutgers University Press, (1965).
- Clark, A. E., "Work, jobs and well-being across the millennium. In Diener, E., Kahneman, D. and Helliwell, J. F (Eds)", *International Differences in Well-Being*, Oxford, UK : Oxford University Press, (2009).
- Deffenbacher, J. L., E. R. Oetting and R. S. Lynch, "Development of a driving anger scale", *Psychological Reports*, Vol.74(1994), 83~91.
- Deffenbacher, J. L., R. S. Lynch, D. M. Deffenbacher and E. R. Oetting, "Further evidence of reliability and validity for the Driving Anger Expression Inventory", *Psychological Reports*, Vol.89, No.3(2001), 535~540.
- Deffenbacher, J. L., R. S. Lynch, E. R. Oetting and R. C. Swaim, "The Driving Anger Expression Inventory : A measure of how peo-

- ple express their anger on the road”, *Behaviour Research and Therapy*, Vol.40, No.6 (2002), 717~737.
- Deffenbacher, J. L., D. M. Deffenbacher, R. S. Lynch and T. L. Richards, “Anger, aggression, and risky behaviour : a comparison of high and low anger drivers”, *Behaviour Research and Therapy*, Vol.41(2003a), 701~718.
- Deffenbacher, J. L., R. S. Lynch, L. B. Filetti, E. R. Dahlen, and E. R. Oetting, “Anger, aggression, risky behavior, and crash-related outcomes in three groups of drivers”, *Behaviour Research and Therapy*, Vol.41(2003), 333~349.
- Diener, E., R. A. Emmons, R. J. Larsen, and S. Griffin, “The Satisfaction With Life Scale”, *Journal of Personality Assessment*, Vol.49 (1985), 71~75.
- Diener, E., E. Suh, and S. Oishi, “Recent findings on subjective well-being”, *Indian Journal of Clinical Psychoogy*, <http://www.psych.uiuc.edu/~ediener/hottopic/paper1.html>, (1997).
- Diener, E. and R. Biswas-Diener, *Happiness : Unlocking the mysteries of psychological wealth*, Malden, MA : Blackwell Publishing, (2008).
- Diener, E., W. Ng, and W. Tov, “Balance in life and declining marginal utility of diverse resources”, *Applied Research in Quality of Life*, Vol.3, No.4(2009), 277~291.
- Diener, E. and K. Ryan, “Subjective well-being : a general overview”, *South African Journal of Psychology*, Vol.39, No.4(2009), 391~406.
- Diener, E., “Assessing well-being : The collected works of Ed Diener”, *Social Indicators Research Series*, Vol.39(2009), The Netherlands, Springer.
- Doob, A. N. and A. E. Gross, “Status of frustrator as an inhibitor of horn-honking responses”, *Journal of Social Psychology*, Vol.76(1968), 213~218.
- El, O. M., <http://www.Planet-Source-Code.com/vb/scripts/ShowCode.asp?txtCodeId=1893&lngWId=2>, (2009).
- Fordyce, M. W., *The happiness measures : A sixty-second index of emotional well-being and mental health*, Unpublished manuscript, Edison Community College, Ft. Myers, Florida, (1977).
- Frey, B. S. and A. Stutzer, *Happiness and economics : How the economy and institutions affect well-being*, Princeton, NJ : Princeton University Press, (2002).
- Fujita, F., *An investigation of the relation between extraversion, neuroticism, positive affect, and negative affect*, Unpublished master’s thesis, University of Illinois, Urbana-Champaign, (1991).
- Helliwell, J. F., C. Barrington-Leigh, A. Harris and H. Huang, “International evidence on the social context of well-being. In Diener, E., Kahneman, D., and Helliwell, J. F. (Eds)”, *International Differences in Well-Being*, Oxford, UK : Oxford University Press, (2009).
- Herzog, A. R. and W. L. Rodgers, “Age and satisfaction : Data from several large surveys”, *Research on Aging*, Vol.3, No.2(1981), 142~165.
- Hong, S. M., “The sub categories of Degree Adverbs in Korean”, *Eo Mun Lon Chong (Korean Language and Literature)*, Vol.36 (2002), 31~74.
- Horley, J. and J. J. Lavery, “Subjective well-being and age”, *Social Indicators Research*, Vol.34, No.2(1995), 275~282.
- Keyes, C. L. M., D. Shmotkin, and C. D. Ryff,

- “Optimizing Well-Being : The Empirical Encounter of Two Traditions”, *Journal of Personality and Social Psychology*, Vol.82, No.6(2002), 1007~1022.
- Kim, E. M., *The meaning of Korean Feeling Verb*. Seoul : Sejong Press, (2002).
- Kim, E. Y., “A Study on the Korean Emotion”, doctor’s thesis, Chonnam National University, (2004).
- Kim, E. Y., “A Study on the Range and the Meaning Characteristics of Emotion Verbs”, *Korean Semantics*, Vol.16(2005), 99~124.
- Kim, K. H., “The study of feeling language’s feature and grammaticality”, *Taegu Review*, Vol.26(1979), 27~50.
- Kim, K. H., “The direction of lexical study of Korean Language for information”, *The symposium of Korean language and Korean languages’ information*, (2000).
- Kim, S. J., “The Lexico-semantic structure of the psychological predicates in Korean. doctor’s thesis”, Seoul National University, (1994).
- Lee, W. K., “The Classification and Properties of Emotive Verbs in Korean”, *Discourse and Cognition*, Vol.13, No.1(2006), 163~182.
- Lucas, R. E., E. Diener, and E. Suh, “Discriminant validity of well-being measures”, *Journal of Personality and Social Psychology*, Vol.71, No.3(1996), 616~628.
- McLinton, S. S. and M. F. Dollard, “Work Stress and Driving Anger in Japan”, *Accident Analysis and Prevention*, Vol.42, No.1(2010), 174~181.
- Park, I. J., “The analysis of Korean affective terms: listing affective terms and exploring dimensions in the affective terms. master’s thesis”, Seoul National University, (2001).
- Potter, P. A., J. M. Govern, H. L. Petri, and M. H. Figler, “Anonymity and aggressive driving behavior : A field study”, *Journal of Social Behavior and Personality*, Vol.10, No.1(1995), 265~272.
- Shaver, P., J. Schwarth, D. Kirson, and C. O’Connor, “Emotion Knowledge : Further Exploration of a Prototype Approach”, *Journal of Personality and Social Psychology*, Vol.52, No.6(1987), 1061~1086.
- Schimmack, U., P. Radhakrishnam, S. Oishi, V. Dzokoto, and S. Ahadi, “Culture, personality, and subjective well-being: Integrating process models of life satisfaction”, *Journal of Personality and Social Psychology*, Vol.82, No.4(2002), 582~593.
- Schimmack, U., S. Oishi, R. M. Furr, and D. C. Funder, “Personality and life satisfaction : A facet level analysis”, *Personality and Social Psychology Bulletin*, Vol.30, No.8(2004), 1062~1075.
- Simsek, O., “Happiness Revisited : Ontological Well-Being as a Theory-Based Construct of Subjective Well-Being”, *Journal of Happiness Studies*, Vol.10, No.5(2009), 505~522.
- Suh, E., E. Diener, and F. Fujita, “Events and subjective well-being : Only recent events matter”, *Journal of Personality and Social Psychology*, Vol.70, No.5(1996), 1091~1102.
- Van Hemert, D. A., van de Vijver, F. J., R., and Y. H. Poortinga, “The Beck depression inventory as a measure of subjective well-being : A cross-national study”, *Journal of Happiness Studies*, Vol.3, No.3(2002), 257~286.
- Watson, D., L. A. Clark, and A. Tellegen, “Development and validation of brief measures of positive and negative affect : The PANAS scales”, *Journal of Personality and Social*

- Psychology*, Vol.54(1988), 1063~1070.
- Wilkinson, R. B. and W. A. Walford, "The measurement of adolescent psychological health : One or two dimensions?" *Journal of Youth and Adolescence*, Vol.27, No.4(1998), 443~455.
- Yasak, Y. and B. Esiyok, "Anger amongst Turkish drivers : Driving Anger Scale and its adapted, long and short version", *Safety Science*, Vol.47, No.1(2009), 138~144.
- Zhang, J., Y. Yang, and H. Wang, "Measuring subjective well-being : A comparison of China and the USA", *Asian journal of social psychology*, Vol.12, No.3(2009), 221~225.

<Appendix> A. The Scoring Result of 99 Anger-related Feeling Verbs

articles	average	articles	average	articles	average
yeokeopda (disgustin6)	8.1	jilsaekhada (loathing)	5.6	bulmanjokhada (dissatisfied)	4.0
jeongohada (loathing)	8.1	jinjurinada (shudder)	5.6	biwidolida (displeased)	3.9
hyeomohada (loathing)	8.1	kyoropda (anguish)	5.6	jikyeopda (boring)	3.9
hwanmyeolhada (disillusive)	7.9	katjanda (ridiculous)	5.5	tuakhada (unappealing)	3.8
buntongteojida (enraged)	7.7	kotongsurupda (painful)	5.5	Jipjiphada (uncomfortable)	3.7
kyeongmyeolhada (scorn)	7.7	sungjilnada (lose temper)	5.4	golnada (angry)	3.7
kyeokbunhada (very furious)	7.6	silda (hateful)	5.4	sigihada (jealousy)	3.6
guyeokjilnada (nauseating)	7.5	jigutjiguthada (tiresome)	5.3	sisaemhada (jealousy)	3.6
nobaldaebalhada (wild rage)	7.5	bulkaehada (unpleasant)	5.1	mipsalsurupda (hateful)	3.6
kyeoknohada (outraged)	7.4	sungnada (angry)	5.0	kaengida (guilty)	3.4
momyeolhada (contempt)	7.3	wonmanghada (resent)	5.0	bulpyeohada (inconvenient)	3.3
moyokhada (insulted)	7.3	jingurupda (creepy)	5.0	jiruhada (boring)	3.2
bunnohada (raging)	7.3	buanada (angry)	4.8	goruhada (outdated)	3.2
jinhada (wrath)	7.2	hungbunhada (upset)	4.8	guichanda (troublesome)	3.1
ulhwachimilda (resentful)	7.0	jilida (sick of)	4.8	goritabunhada (stuffy)	2.9
bungaehada (infuriated)	6.9	sinmulnada (sick and tired of)	4.7	mulida (fed up)	2.9
chitulda (chagrin)	6.8	mipda (hateful)	4.6	torajida (sulky)	2.8
kyeokanghada (incense)	6.8	banhanghada (rebellious)	4.6	pyeoropda (bothersome)	2.7

bunhada (furious)	6.7	yeomjungnada (get sick and tired of)	4.5	gulida (trapped)	2.7
wontonghada (resentful)	6.6	tugihada (jealousy)	4.5	pyorotonghada (sulky)	2.5
kyeokhada (agitated)	6.3	motmatanghada (displeased)	4.5	saemnada (jealousy)	2.5
yeokjungnaeda (upset)	6.2	unjanta (displeased)	4.4	eosusunhada (untidy)	2.5
ulbunhada (frustration)	6.2	jiltuhada (jealous)	4.4	saeljukhada (sulky)	2.5
geosimhada (disgusted)	6.1	soksanghada (distressed)	4.4	siksanghada (fed up)	2.5
jajungnada (irritated)	6.1	jinreoknada (get tired of)	4.3	sikundunghada (apathetic)	2.5
yeokjungnada (upset)	6.0	sungasida (annoying)	4.3	sisihada (trivial)	2.3
nohada (angry)	6.0	yalmipda (hateful)	4.3	pyeonchanda (unwell)	2.3
noyeopda (mad)	5.9	kasoropda (ridiculous)	4.2	sidulhada (indisposed)	2.3
musihada (disregard)	5.9	gaetanhada (deplore)	4.2	simdurunghada (dragged)	2.2
gajungsurupda (contemptible)	5.9	simtongnada (crooked)	4.2	namburupda (envious)	1.6
hwanada (angry)	5.8	yakoruda (irritated)	4.1	bureoweohada (envious)	1.3
sinkyongjilnada (nervous)	5.8	tathada (blame)	4.1	burupda (envious)	1.3
balkunhada (raging)	5.6	bulpyeonghada (complain)	4.1	tonggyeonghada (longing)	1.0

Abstract

정신적 건강 서비스를 위한 감성구를 활용한 주관적 웰빙 지수 측정 방법론

권오병* · 최석재**

상황인식 컴퓨팅 사용자의 상황적이고 주관적 웰빙(SWB) 측정은 그에 맞는 정신건강 추천, 특히 대사증후군이나 우울증을 위한 추천에 매우 도움이 될 것이다. 현존하는 자가 진단식 측정법이나 자가 센싱 방법이 주관적 웰빙 정보를 모니터링 하는데 제안되고 있음에도 불구하고 시의 적절한 서비스를 제공하지 못하여 상황인식 서비스로 쓰이기에는 부적합하다. 따라서 본 논문의 목적은 상황적이고 주관적 웰빙을 추정하는 방법을 제안하는 것이다. 이 방법은 사용자가 남기는 응답 글로부터 상황 자료를 획득하기 때문에 매우 적시적이며 따라서 그때마다의 감정 상태를 파악할 수 있다. 특히 본 연구에서는 온라인 대화나 기타 텍스트 기반의 의사소통에서 노출되는 분노심 등 부정적 감정에 관련된 감정동사와 정도 부사에 초점을 두어 측정한다. 제안된 상황적이고 주관적 웰빙 추정 방법을 기반으로 하여 웰빙 생활을 위한 추천 시스템을 개발하고자 한다. 이러한 아이디어의 실현가능성을 보이기 위하여 실제 운전자들을 대상으로 제안 방법이 얼마나 실제 감정을 잘 추론하는지에 대해 실험을 수행하였다.

Keywords : 주관적 웰빙, 부정적 감정, 상황인식적 서비스, 삶의 만족도, 개인 운전 분노 상황

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