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A Study on Reinforcement of Self-Directed Learning using Controlling Face Emotion

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Abstract: ***This paper deals with emotion-based self-directed teaching and learning in online education. Teachers and learners cannot understand how much their communication exchanges well with each other. So, their teaching and learning efficiency decreases than their expectation. To increase teaching and learning efficiency, this paper analyzes face emotional patterns to figure out which emotion segments have dominant facts in teaching and learning through Korean women's face data. These dominant factors are sent to control for improving self-directed learning. In the control system, deep learning compares face data with reference data and finally decides the control signal to improve self-directed learning.***

Keywords**:** ***Face Emotion, Online Education, Self-Directed Teaching and Learning, Emotion Reinforcement.***

I. INTRODUCTION

Uncontacted learning situation has been becoming after C-19 and this situation will be continued even social situation recovers. That is, the spread of C-19 compulsorily changes from the traditional face-to-face education in the classroom to the online education system in the K-12 education system as well as the higher education system.

Therefore, students and parents as well as teachers including professors and online related companies have to adjust or develop new teaching and learning methods, online teaching tools, and technologies. Unprepared teachers and parents have to introduce this online education system into their K-12 education system as well as a higher education system to fulfill the required condition for teaching and learning [7].

Unfortunately, this unexpected situation will continue for the time being in education and a new paradigm has been developed at both the social and the educational levels because of the unexpected spread of C-19. We also must consider a fundamental change in the education system such as K-12 including university because this circumstance will continue for the time being.

Online education started from distance learning has a long history but there are still many barriers in teaching skills as well as learning. That is why the low efficiency of teaching and learning, a lacking online teaching tool.

Herein, we must consider how we must increase the efficiency of online education and what kind of tool is useful for online education.

Usually, when teachers teach teaches and students learn in the classroom, they can communicate easily because they can meet directly through face-to-face as well as gesture and talking style.

However, when they teach and learn through online tools, teachers cannot understand exactly the level of students' understanding and students are not able to have a motivation to engage in class because the teacher is not able to see the students' faces and gestures.

That is, a self-directed learning way is required to introduce for teaching and learning efficiency. However, it is not easy to implement learning and teaching in class because its conception and research are so powerful to apply in the education site.

This paper suggests a novel self-directed learning and teaching method through face emotional pattern analysis. This paper, firstly, recognizes and analyzes face emotion, and secondly, mentions control structure for reinforcement method of self-directed leaching and learning.

II. LITERATURE REVIEW

Online education has a long history as shown in Figure 1 and it started in the 1700s.

However, MOOCs built their activity like current online education from 2012 and they offer massive open online courses as regular degree courses (The University of Wisconsin's BS degree course). The first online-only public university in the United States In 2013. UF was announced online in 2014 [1-3].

Purdue University (Carl Behnke and James P. Greenan tested the relationship between postsecondary course emotional-social intelligence and attitudes toward computer-based instructional materials [1]. This research presents that emotional intelligence directly influences the motivation of online education and gives an impact on student attitudes. However, this research did not deal with the relationship between face emotion and online education.

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Felicia K. Oluwalola [2] mentioned the importance of environmental situations like technology in online education because technophobia like computers or others can give frustration and anxiety. However, he did not mention emotion and the online education effect.

This paper [3] studies the relationship between emotion and education not in online education. The adult does not have influence from emotional situations like children but emotion gives impact both ways like negatively and positively.

Figure 1. The history of online education summarized by author's opinion.

Melanie Stephan et el [4] analyze students' technology acceptance and achievement emotions in an online course through survey data of 182 students. He mentions that positive emotion is more acceptance than negative emotion.

Ref. [5] suggests a method that recognizes the emotions of the student in an e-learning environment and provides a real-time feedback mechanism to enhance the e-learning through the detection of eyes. They propose a better content delivery and learner's concentration method using analyzing emotion of this eye.

Also, there are many research materials to face emotion recognition [8-14]. However, there is no mention of the relationship between emotion and online education. Also, there is voice emotion [15], EEG signal and emotion [16], gesture and emotion but these are out of the research area of this paper.

A. Emotion and Self-Directed Learning

Emotions improve memory and lead to more learning abilities through permanent memory [24]. This paper [24] describes one of the information that makes the amygdala, which is used for emotional memory processing stimulation. That is, the amygdala interprets the information in order to determine the emotional and emotional activities that help students learning abilities.

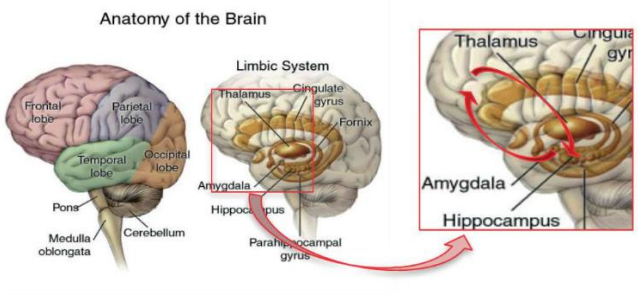

Figure 2. Stimulation process in the brain for emotion [24].

Emotions also can provide selectively an individual's attention to particular stimuli [25]. This paper mentions that neural correlates of emotional memories and cognition is done from processes such as memory, attention, language, problem-solving, and planning.

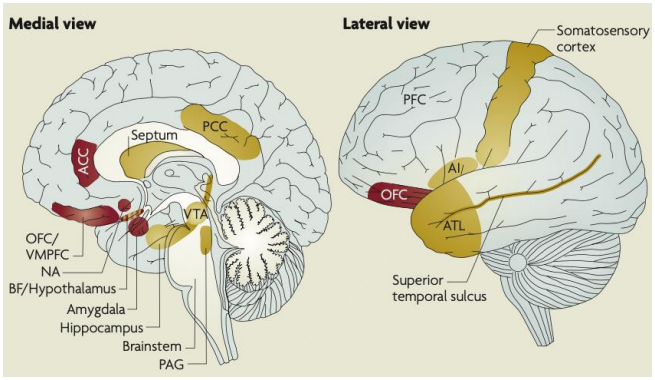

Figure 3. Signal processing of emotional brain described in Ref. 25.

This paper [26] examines the impacts of self-directed learning, technology readiness, and learning motivation on the three presences (social, teaching, cognitive) among students undertaking subjects in BL (Blended Learning) and non-BL (Non-Blended Learning) settings. So, this paper strength the importance of technology facility but it is not included in this paper.

This reference [27] illustrates a novel mechanism to allow for culturally shared emotional meanings. That is, this paper describes that the adoption and effectiveness of cognitive is linked with emotion. ("the adoption and effectiveness of cognitive This paper assistive technologies hinge on harnessing the dynamics of human emotion"). The authors introduce the integration of emotions for assistive technologies of dementia. and propose Bayesian Affect Control Theory.

Chai M. Tyng et el [28] mention strongly that "motion has a substantial influence on the cognitive processes in humans, including perception, attention, learning, memory, reasoning, and problem-solving." This paper describes that "emotion has a particularly strong influence on attention, especially modulating the selectivity of attention as well as motivating action and behavior. This attentional and executive control is intimately linked to learning processes, as intrinsically limited attentional capacities are better focused on relevant information." "Emotion also helps retrieval of information efficiently. However, the effects of emotion on learning and memory are not always univalent, as studies have reported that emotion either enhances or impairs learning and long-term memory (LTM) retention, depending on a range of factors."

This paper [29] studies the emotional relationship between teacher and learner in self-directed language learning through counseling interviews. This paper measure counselors' and learners' emotional states that can infer from the tone of voice through analysis of audio recordings of their exchanges. This paper suggests that counselors should regulate emotions in order to maintain an emotional climate because emotions are characterized on valence and activation scales and emotional fluctuations can give an influence on learner's initiation and results.

This study [30] shows that there is a significant relationship between self-directed learning and emotional intelligence as measured by The Emotional Quotient Inventory.

B. Self-Directed Learning

As self-directed learning is important key work in education, it has been around since the beginnings of cognitive development (Aristotle and Socrates). Self-directed learning should be kept in the classroom for how we learn, how we should develop more meaningful learning and teaching for students and learners.

Currently, it is more interesting for many educators because many educators' roles and responsibilities are important in online teaching and learning.

Self-directed learning can contribute to actively participating as well as discovering self-learning information and thinking about their study.

This paper [31] studies the relationship between the self-leadership questionnaire and the online learning attitude scale through the survey.

This review paper [32] mentions that self-directed learning links from teacher-directed at one end to self-determined at the other. Students' readiness and willingness depend on many factors such as personality, ability to self-regulate, prior experiences, self-efficacy, domain-specific knowledge/skill, motivation, and existing context and circumstances because self-directed learning represents a process of learning that is individual, purposeful, and developmental.

Ref. [32] describes that self-directed change is an intentional change in an aspect of who you are (i.e., the Real) or whom you want to be (i.e., the Ideal), and this paper shows self-directed learning is the self-directed change in which you are aware of the change and understand the process of change.

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Figure 4 shows the structure for the efficiency analysis of self-directed learning [35]. This data and signal are used in the control system in Figure 16.

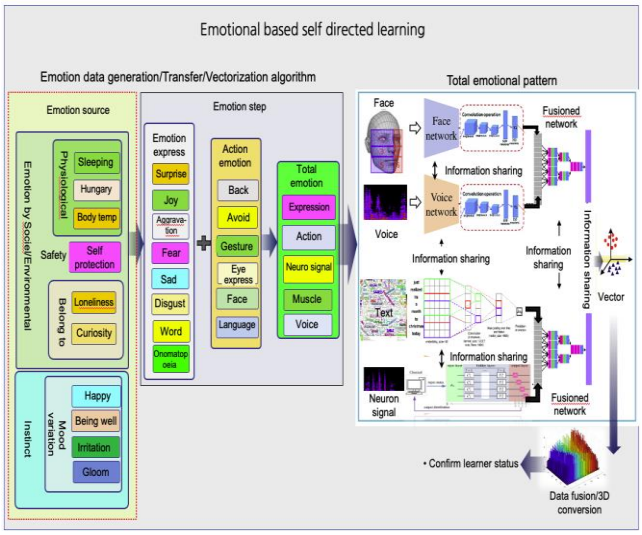

Figure 4. Kim's figure for self-directed learning.

Though early research suggested that certain intelligence and personality traits were fixed, a large body of recent research refutes these findings, showing instead that such traits are malleable. Thus, one can develop and improve cognitive functions and intrapersonal skills associated with self-directed learning.

The quality of university education and its outcomes depends largely on the quality of university lecturers. As such, the purpose of

III. FACE EMOTION ANALYSIS OF KOREAN WOMWN FOR SELF-DIRECTED LEARNING

There are many ways for emotion expression such as face emotion, body emotion, gesture emotion, voice emotion, EEG emotion, eye emotion, and text emotion. The pattern of this emotion must be classified and recognized for use in technology development. For instance, VR, AR, communication, and others.

In the case of face emotion, almost they use 7-segments as emotion expression such as angry, disgusted, fearful, happy, sad, and surprised, and neutral [34]. This also uses this 7-segment expression for emotion classification to face emotion.

This paper's main aim is to develop a reinforcement method of self-directed learning in online teaching and learning using a pattern of facial emotion. Therefore, this paper classifies Korean women's facial emotions as shown in Figure 5-13.

To classify, this paper uses the previous data set [35]. Figure 5, 6 shows the emotion pattern results of the test data set of face picture by using deep learning. Figure 5 is the emotion pattern of test data by deep learning and Figure 6 presents the learning process of deep learning for the emotion pattern of data.

Figure 5. Emotion pattern of test data by deep learning.

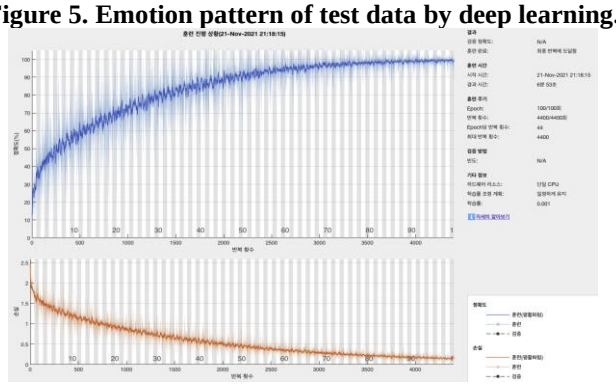

Figure 6. Learning process of deep learning for emotion pattern of data.

Figure 7 shows the emotion pattern of training data deep learning and Figure 8 illustrates the learning process of deep learning for emotion pattern of data. Figure 9 is a variation of the emotion pattern of a face on the training dataset by another deep learning module.

Figure 7. Emotion pattern of training data by deep learning.

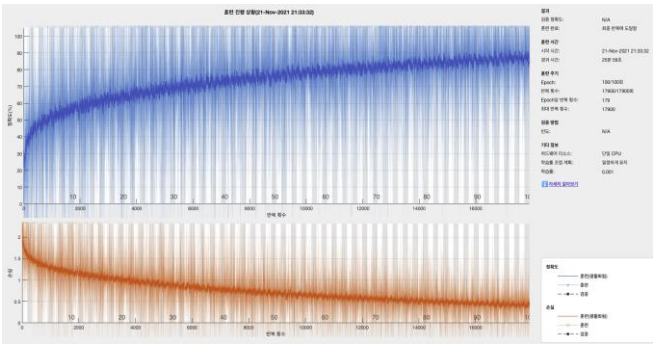

Figure 8. Learning process of deep learning for emotion pattern of data.

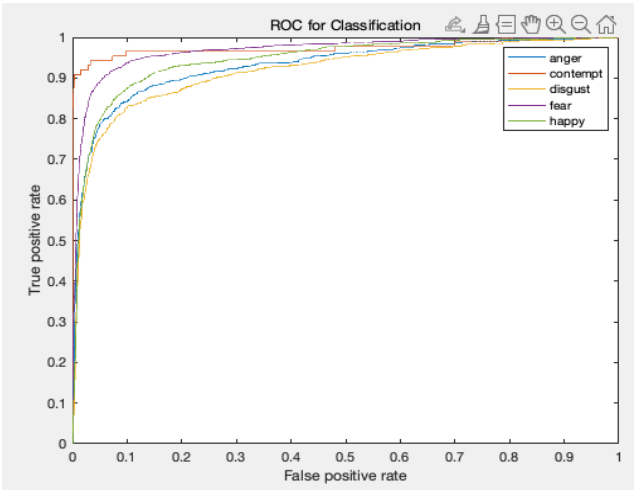

Figure 9. Variation of emotion pattern of the face on training dataset by another deep learning module.

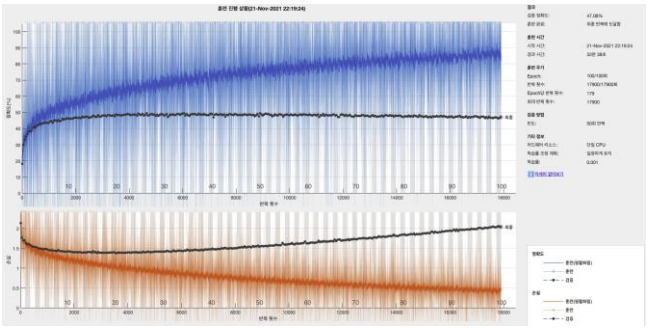

Figure 10. Learning process of another deep learning module for emotion pattern of test data.

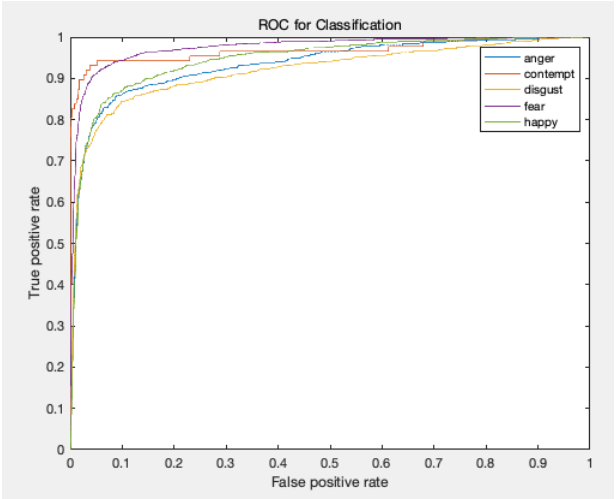

Figure 11. Variation of emotion pattern of the face on training dataset by another deep learning.

Figure 10 shows the learning process of another deep learning module for the emotion pattern of test data by using another deep learning module. Figure 11 is a variation of the emotion pattern of the face on the training dataset by another deep learning.

Figure 12 is the emotion pattern of data by another deep learning module and Figure 13 presents the learning process of another deep learning module for the emotion pattern of test data.

Figure 14 shows an emotional pattern of a classified Korean woman's face. The photos of the left side are dataset face and right-side data shows classified woman face emotion pattern through Korean woman's face.

Emotion expresses with 7-segment of happy, sad, disgust, neutral, fear, anger, and surprise. Figure 15 shows the graphic expression of Figure 14 to compare the size of the emotion pattern.

Figure 16 illustrates the structure of the emotional control system for self-directed learning. The input layer has data in Figure. 14 as input and computed by the hidden layer through learning. The hidden layers select and decide after comparing emotional parameters with feedback gain. The dominant value is sent to the robot (learner) to stimulate. These processes continue to obtain finally the requisite value.

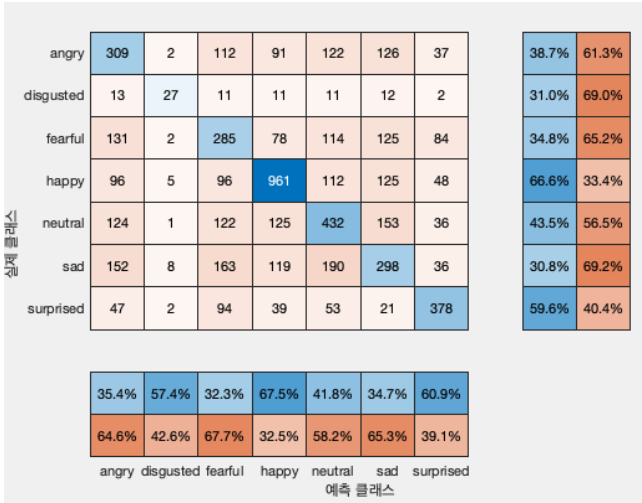

Figure 12. Emotion pattern of data by another deep learning module.

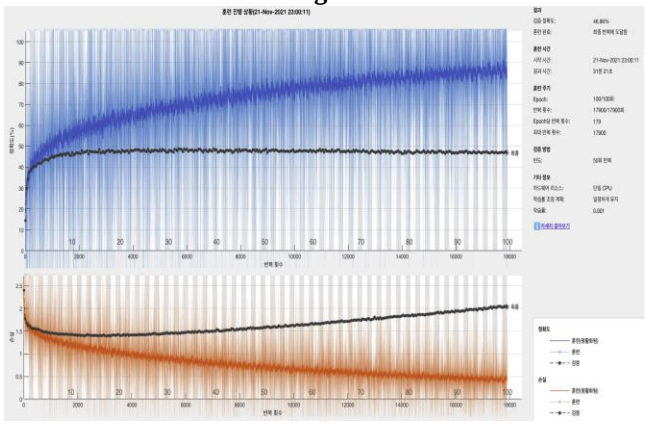

Figure 13. Learning process of another deep learning module for emotion pattern of test data.

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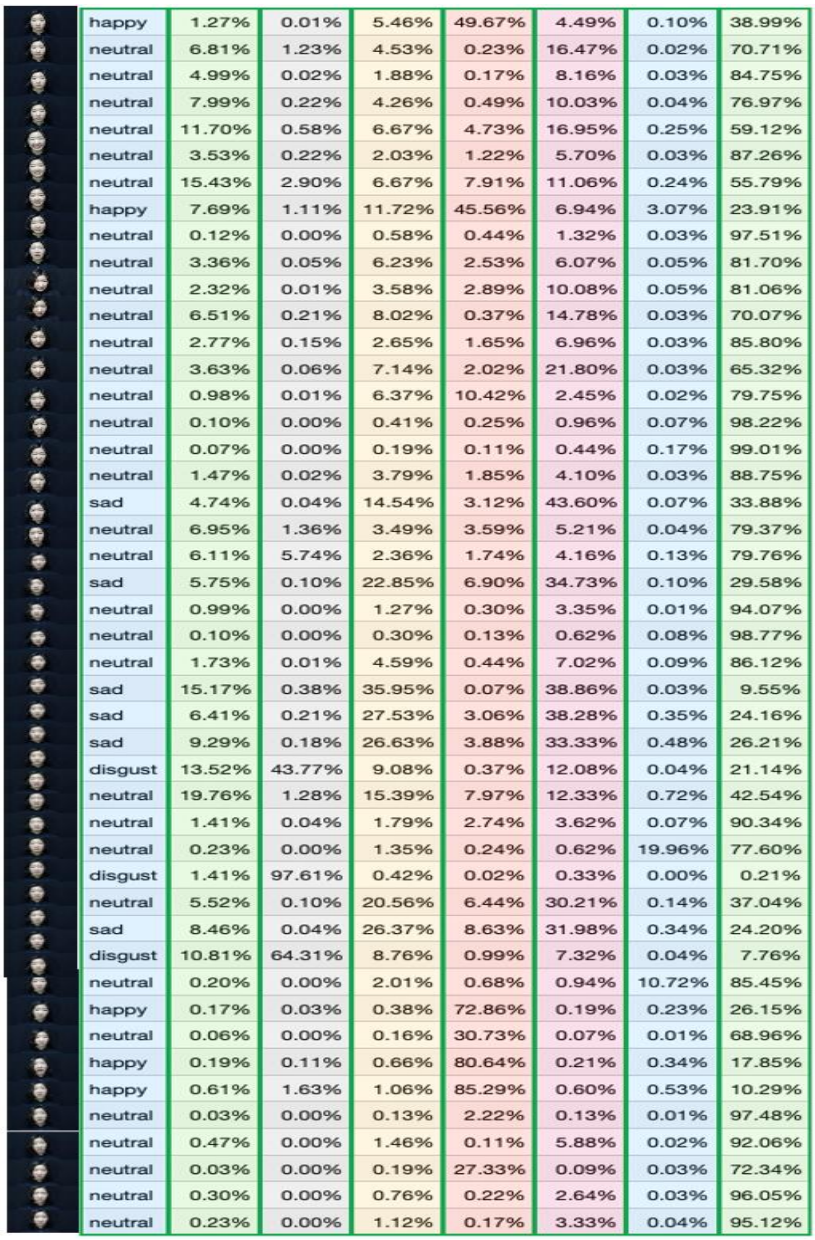
VI. CONTROL FOR REINFORCEMENT DOMINANT FACTOR OF EMOTIONAL FUNCTION

This paper's final aim is to design how we select the dominant factor for reinforcement and stimulate the dominant factor of emotional function for self-directed learning in online learning and teaching. For that, this paper designs a control system as shown in Figure 16.

In Figure 16, all input selected in Figures 14, 15 enter into a neural network and this neural network compares with the reference value. The neural network produces the final value after comparing with reference as the final control signal. Of course, this paper will test and experiment on the robot system in further works.

V. CONCLUSION

This paper designs a control system to produce emotional stimulation action (behavior) through a neural network's learning function. This stimulation signal is compared with the feedback signal and is obtained optimal signal to the robot (leaner). Figures 5, 7, 12, 14, and 16 show the surprise function as the biggest stimulation. It means that when we teach, we must introduce a surprise function in content or a similar situation. This paper also suggests a control system for the dominant factor of emotional factor to carry out effective online education. This paper aims to control emotional parameters for self-directed learning. For that, this paper classifies and analysis Korean women's emotional pattern such as happiness, fear, anger, disgust, neutrality, surprise, and sadness.



happy	1.27%	0.01%	5.46%	49.67%	4.49%	0.10%	38.99%
neutral	6.81%	1.23%	4.53%	0.23%	16.47%	0.02%	70.71%
neutral	4.99%	0.02%	1.88%	0.17%	8.16%	0.03%	84.75%
neutral	7.99%	0.22%	4.26%	0.49%	10.03%	0.04%	76.97%
neutral	11.70%	0.58%	6.67%	4.73%	16.95%	0.25%	59.12%
neutral	3.53%	0.22%	2.03%	1.22%	5.70%	0.03%	87.26%
neutral	15.43%	2.90%	6.67%	7.91%	11.06%	0.24%	55.79%
happy	7.69%	1.11%	11.72%	45.56%	6.94%	3.07%	23.91%
neutral	0.12%	0.00%	0.58%	0.44%	1.32%	0.03%	97.51%
neutral	3.36%	0.05%	6.23%	2.53%	6.07%	0.05%	81.70%
neutral	2.32%	0.01%	3.58%	2.89%	10.08%	0.05%	81.06%
neutral	6.51%	0.21%	8.02%	0.37%	14.78%	0.03%	70.07%
neutral	2.77%	0.15%	2.65%	1.65%	6.96%	0.03%	85.80%
neutral	3.63%	0.06%	7.14%	2.02%	21.80%	0.03%	65.32%
neutral	0.98%	0.01%	6.37%	10.42%	2.45%	0.02%	79.75%
neutral	0.10%	0.00%	0.41%	0.25%	0.96%	0.07%	98.22%
neutral	0.07%	0.00%	0.19%	0.11%	0.44%	0.17%	99.01%
neutral	1.47%	0.02%	3.79%	1.85%	4.10%	0.03%	88.75%
sad	4.74%	0.04%	14.54%	3.12%	43.60%	0.07%	33.88%
neutral	6.95%	1.36%	3.49%	3.59%	5.21%	0.04%	79.37%
neutral	6.11%	5.74%	2.36%	1.74%	4.16%	0.13%	79.76%
sad	5.75%	0.10%	22.85%	6.90%	34.73%	0.10%	29.58%
neutral	0.99%	0.00%	1.27%	0.30%	3.35%	0.01%	94.07%
neutral	0.10%	0.00%	0.30%	0.13%	0.62%	0.08%	98.77%
neutral	1.73%	0.01%	4.59%	0.44%	7.02%	0.09%	86.12%
sad	15.17%	0.38%	35.95%	0.07%	38.86%	0.03%	9.55%
sad	6.41%	0.21%	27.53%	3.06%	38.28%	0.35%	24.16%
sad	9.29%	0.18%	26.63%	3.88%	33.33%	0.48%	26.21%
disgust	13.52%	43.77%	9.08%	0.37%	12.08%	0.04%	21.14%
neutral	19.76%	1.28%	15.39%	7.97%	12.33%	0.72%	42.54%
neutral	1.41%	0.04%	1.79%	2.74%	3.62%	0.07%	90.34%
neutral	0.23%	0.00%	1.35%	0.24%	0.62%	19.96%	77.60%
disgust	1.41%	97.61%	0.42%	0.02%	0.33%	0.00%	0.21%
neutral	5.52%	0.10%	20.56%	6.44%	30.21%	0.14%	37.04%
sad	8.46%	0.04%	26.37%	8.63%	31.98%	0.34%	24.20%
disgust	10.81%	64.31%	8.76%	0.99%	7.32%	0.04%	7.76%
neutral	0.20%	0.00%	2.01%	0.68%	0.94%	10.72%	85.45%
happy	0.17%	0.03%	0.38%	72.86%	0.19%	0.23%	26.15%
neutral	0.06%	0.00%	0.16%	30.73%	0.07%	0.01%	68.96%
happy	0.19%	0.11%	0.66%	80.64%	0.21%	0.34%	17.85%
happy	0.61%	1.63%	1.06%	85.29%	0.60%	0.53%	10.29%
neutral	0.03%	0.00%	0.13%	2.22%	0.13%	0.01%	97.48%
neutral	0.47%	0.00%	1.46%	0.11%	5.88%	0.02%	92.06%
neutral	0.03%	0.00%	0.19%	27.33%	0.09%	0.03%	72.34%
neutral	0.30%	0.00%	0.76%	0.22%	2.64%	0.03%	96.05%
neutral	0.23%	0.00%	1.12%	0.17%	3.33%	0.04%	95.12%

Figure 14. Emotion pattern classification of a Korean woman (data).

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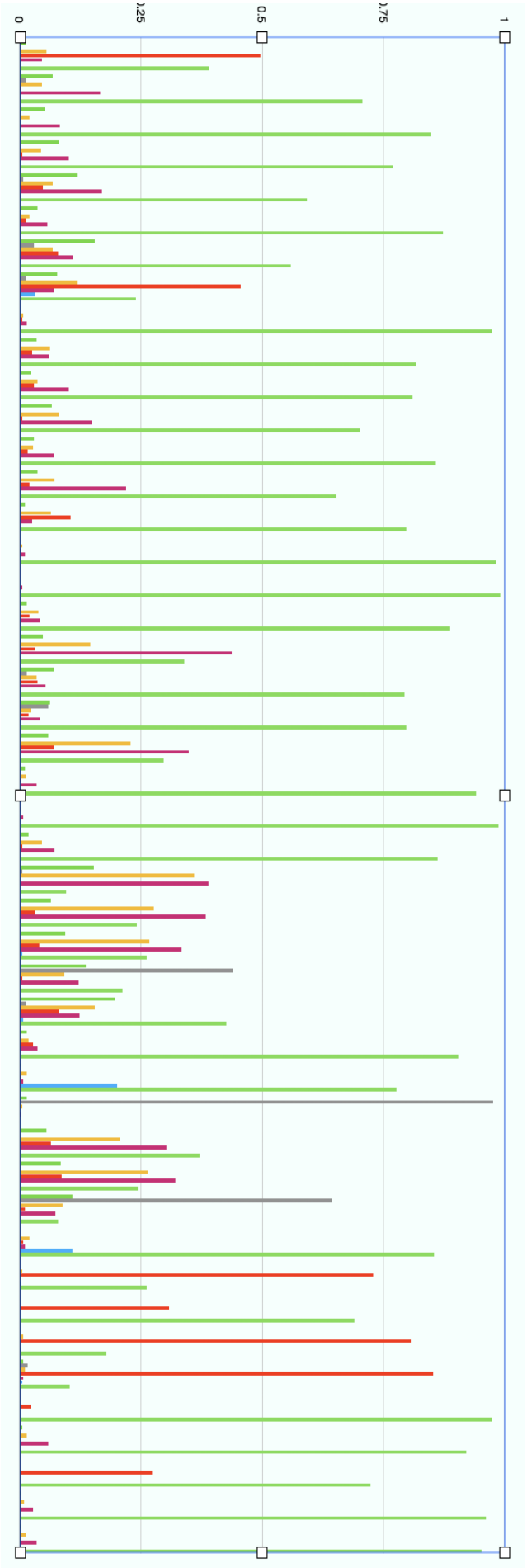

Figure 15. Emotion pattern classification graph of Figure 14 (graph).

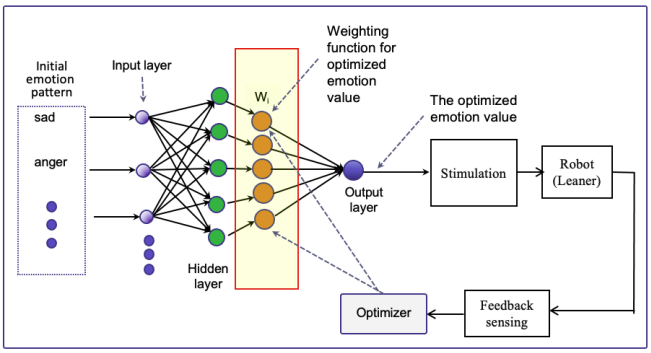

Figure 16. The structure of emotional control system for self-directed learning.

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