Development of Flatform for AI Psychological Diagnosis Chatbot with Language Pattern Deep Learning model

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ABSTRACT

Many people in Korea are hesitant about psychological counseling because of the social judgement of mental illness. To overcome these barriers, online computer-based counseling has emerged. There are some benefits of artificial intelligence psychological counseling services. However, the most frequently used AI psychological counseling service, the Counseling Chatbot, has some limitations such as possibilities of cognitive suppression, low accuracy of diagnosis due to low data. Therefore, in this study, a mid-level psycho-diagnostic support service was proposed by converging AI with traditional psycho- diagnostic methods through human counselors to remove barriers of previous mental counseling systems such as social prejudice against mental illness, and time/space/cost constraints, which were conducted by human health professionals. It provided a platform for easy learning of psychopathic models to enable diagnosis

I. Introduction

According to the results of the 2016" Epidemiological Survey on the Status of Mental Diseases," the lifetime prevalence rate of 17 major mental illnesses in South Korea was 25.4 percent. One in four adults suffers from mental illness more than once in their lifetime, but only one in ten have

consulted with experts on mental health issues. The reason for the low utilization rate of mental health services is thought to be that prejudice against mental illness in Korean society has many influences. Despite empirically proving that psychotherapy, such as counseling, is an effective way to solve human mental problems, many of South Koreans do not ask for professional help because there is a risk of whole family being judged as psychological patients in Asian cultures where family collectivism is strong. Because of this, many Koreans hide their psychological problems in family secrets

and remain defensive about psychological treatment. To overcome these barriers, new psychological counseling services using artificial intelligence chatbot technology is developed instead of traditional face-to-face methods. There are some benefits of artificial intelligence psychological counseling services; no physical constraints, such as time, cost, and environment, free from fear of social judgement, artificial intelligence counselors do not show signs of fatigue or exhaustion, unlike human counselors. However, the most frequently used AI psychological counseling service, the Counseling Chatbot, has some limitations. There are possibilities of cognitive suppression in the process of expressing one's feelings to AI and low accuracy of diagnosis due to low data deep learning. So, this study developed AI psychological diagnosis assistant app which can collaborate with human counselor. This approach allows for natural and emotional dialogue through human counselors, while also through using AI speakers to enable getting the client's response easily for obtaining diagnostic databases.

II. Related Research

Currently, research is actively underway to analyze differences from normal groups by analyzing the language of psychiatric patients using AI. Mohamed Al-Mosaiwi(2018) said in a short words of depressed people that there was a significant difference in normalcy. People who are depressed often use first-person singular pronouns such as me, myself, and I. They used fewer two-person or three-person pronouns such as you, them, and her. The habit of using a lot of first-person singular pronouns shows that people with depression are more focused on themselves, and less connected to others. Researchers said pronouns are more reliable means of distinguishing depression than words that express negative emotions. People with symptoms of depression used many words to express absolute ratings or absolute possibilities such as always, nothing, and completely. This type of thinking is a common characteristic in people with suicidal thoughts or borderline personality disorder (BPD) or eating disorders. Previous research showed that it is possible to diagnosis depression with language diagnosis, but used only word counting technique not considering the context or pattern of language use.
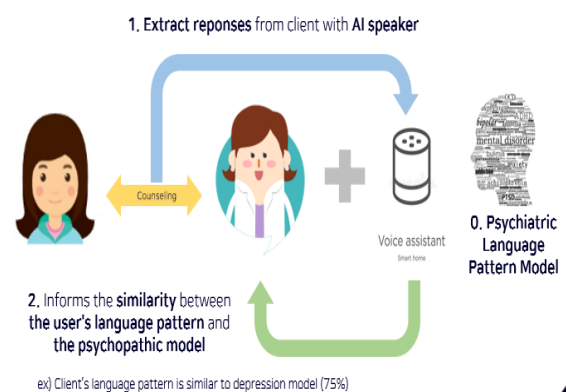
III. Research Methodology

Fig1. Process of Flatform for Psychological Diagnosis Chatbot

3.1 Chatbot Flatform Development
A. Google Assistant App
This study used Dialogflow, Google's chatbot development platform, to extract

responses from users perceived as AI speakers. Dialogflow is easy and simple to design chatbot, and it is also very easy to link it with major messenger platforms such as Facebook and Telegram, including Google's Assistant app, enabling various chatbot implementations. Therefore, this study used Dialogflow to develop apps in Google Home, Google's AI speaker. The app not only extracts the user's voice text for diagnosis, it also functions to send a diagnostic result message to the counselor.
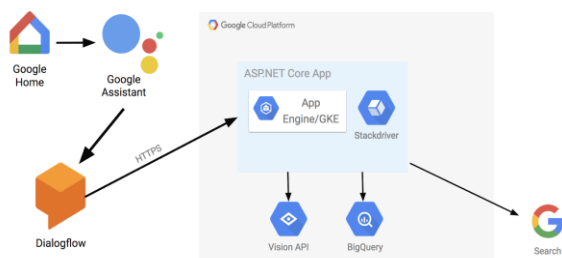

Fig2. Process of Dialogflow with Google Assistant App

3.2 Pathological Language Pattern Analysis

In this study, to improve the diagnosis result, the doc2vec deep learning technique is used to measure context similarity together with word frequency as in previous studies.

A. Word Frequency

In order to diagnose the word frequency, It is necessary to create the characteristic word corpus of the psychopathologic model through the NLP process. Two NLP packages were used in this study: Mecab, and Soynlp. Mecab is a Python package with the best processing speed and accuracy among Korean language morphers. In this study, the reason why Soynlp is used together with Mecab is because it

allows tokenization through machine learning without user-dictionary based on cohesion which can extract culture-reflective words. In the process of processing users' input text with natural language processing, Soynlp is used to compensate for the advantages of boasting a high speed and the Mecab's inability to correctly separate pronouns reflecting a particular culture.

Mecab
[('행복', 'NNG'), ('관', 'NNG'), ('에', 'JKB'), ('사', 'VV'), ('는', 'ETM'), ('게', 'NNB+JKS'), ('가끔', 'MAG'), ('힘', 'NNG'), ('이', 'JKS'), ('들', 'VV+ETM'), ('때', 'NNG'), ('가', 'JKS'), ('있', 'VA'), ('어', 'EC')]

Soynlp
['행복관', '에', '사는', '게', '가끔', '힘', '이', '들', '때', '가', '있어']

Fig3. Difference between Mecab and Soynlp in tokenizing

The morphology of the Korean language can be divided into semantic and formal morpheme, since semantic/ meaning morpheme affects the meaning and context of sentence, only semantic morpheme was selected in this process to measure the frequency. The meaning morphemes extracted in this process are general nouns, proper nouns, pronouns, general local adverb, conjunctive adverb, general local adverb, and adjectives.

B. Context Similarity

For diagnosing context similarity with psychiatric model, Doc2Vec embedding model is used. Doc2vec is an algorithm to generate vectors for sentence, paragraphs, and documents. The goal of doc2vec is to create a numeric representation of a document, regardless of its length. The

vectors generated by doc2vec can be used for tasks like finding similarity between sentences, paragraphs, and documents. As Doc2Vec thinks document id is a word, the document id corresponding to the sentence has the coordinates of the position in the semantic space. To find out context similarity, top five sentences showing high cosine similar vectors is extracted and the mean of similarity of input sentence is calculated. Cosine similarity is a measure of similarity between two non-zero vectors of an inner product space that measures the cosine of the angle between them. The cosine of $0°$ is 1, and it is less than 1 for any angle in the interval $(0,\pi]$ radians.

Fig 4. Doc2Vec Embedding and Cosine Similarity Sample

IV. Research Experiment

In relation to research ethics, it is currently difficult to obtain counseling session data to study psychopathic models. Thus, for the experiment, in order to prove the driveability of the platform, it takes the process of learning the language pattern model of the students of Handong University instead of the psychopathic model. In order to build the data base of the language pattern model of the students of Handong, two data are gathered with data crawling: Handong Kakao Chat, and Everytime. First, data is gathered through Handong Kakaotalk Group which is used by more than 2000 students in Handong University. Second, also app Everytime which is an famous application within university students for providing anonymous community for each university is used to obtain data. As a result, about 40,000 of data are acquired for experiment. For making word corpus which Handong students frequently use, several meaning morphemes are extracted [Figure 5].

Fig 5. Wordcloud image of Handong Word Corpus

V. Research Result

Figure 5 shows image of the AI psychological diagnosis chatbot prototype running on the Google Assistant application. As seen in the below [Figure 6], firstly, counselor call the prototype app which is

called my counselor with voice or text. The chatbot response and alarms the start of diagnosis. With voice tracking or texting, client's responds are automatically extracted. Then it calculated the word similarity and context similarity and show the result of both. These are the specific example that showed High similarity to low similarity [Figure 6].

At the first example, many words in Handong corpus are used in user's respond text such as "새섬", "학기", or "새내기". As a result of tokenizing the user's responses, the word similarity, the portion of meaning morphemes, were calculated as 100% because there were a total of eight semantic morphemes (이번, 학기, 새섬, 새내기, 기파, 준비, 애들, 좋) and all eight of them were words that were frequently used in Handong, or words that existed within the Handong Corpus. For context similarity, as the top 5 cosine similarity vector are 0.81463, 0.81257, 0.81195, 0.81190, 0.80824, the mean of these are calculated to 85.5%.

For second example, text data from students at other universities, not from Handong University, is obtained to see the difference between the first example and produced the diagnosis results through a chatbot model. Word similarity is calculated to about 44% as there were a total of five semantic morphemes and two of them (이번, 너무) were words that were frequently used, and the frequency of each meaning morphemes in Handong Corpus is added to the percent. In addition, the context similarity of user's input text was analyzed lesser than first example because

language usage patterns were also different from the students at Handong University.

In the last example, in order to analyze whether Handong Corpus model really is gone through deep learning well and there is a significant difference between a student at Handong University and a regular sentence, arbitrarily took a sentence from the Internet article and analyzed it. At the third example, when compared to the second example, the similarity of the words does not differ, but rather the third example appears a little higher. However, when context similarity was measured through doc2vec deep learning, it was found that there was a difference of about 10% from the second example. Therefore, it could be determined that the contextual analysis through deep learning is more accurate to use together than the existing study method of measuring only the frequency of words.
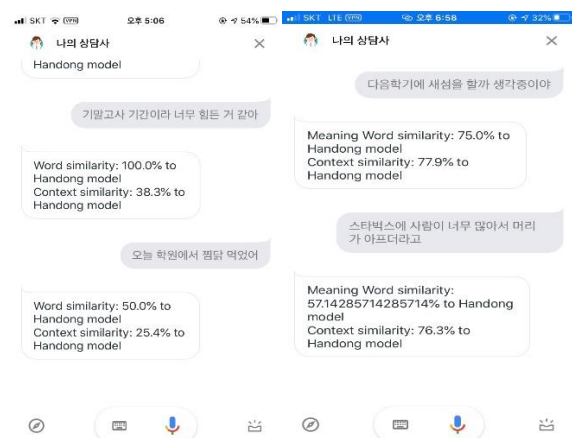

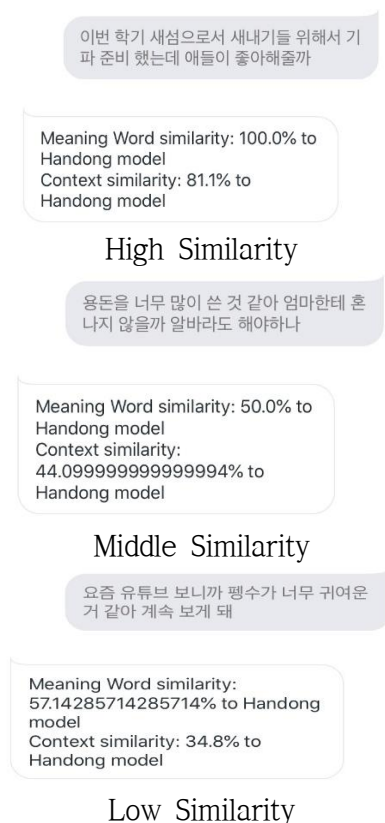Fig 6. AI psychological diagnosis chatbot prototype

이번 학기 새섬으로서 새내기들 위해서 기파 준비 했는데 애들이 좋아해줄까

Meaning Word similarity: 100.0% to Handong model
Context similarity: 81.1% to Handong model

High Similarity

용돈을 너무 많이 쓴 것 같아 엄마한테 혼나지 않을까 알바라도 해야하나

Meaning Word similarity: 50.0% to Handong model
Context similarity: 44.099999999999994% to Handong model

Middle Similarity

요즘 유튜브 보니까 펭수가 너무 귀여운 거 같아 계속 보게 돼

Meaning Word similarity: 57.14285714285714% to Handong model
Context similarity: 34.8% to Handong model

Low Similarity

Fig 7. Diagnosis result continuum from High to Low

VI. Conclusion

In this research, unlike the traditional counseling sessions, which only involve human counselors, or the recent counseling chatbot, which uses only AI alone, a mid-level psycho-diagnostic support service was proposed by converging AI with traditional psycho- diagnostic methods through human counselors and provides a platform for easy learning of psychopathic models to enable diagnosis. This approach can take the advantage of using AI such as No physical constraints, no fear of social judgement, and not showing signs of fatigue or exhaustion and also solve limitations of using it with collaborating with human counselor. As it wasn't possible to obtain counseling session data to study

psychopathic models in relation to research ethics, it takes the process of learning the language pattern model of the students of Handong University instead of the psychopathic model. From the research result, context similarity was measured through doc2vec deep learning, and it was found that there is a difference of analysis result between handong students' texts and non-handong texts. Also, the contextual analysis through deep learning is more accurate to use together than the existing study method of measuring only the frequency of words. For further studies, solve research ethics problems, collect texts from actual mental patients, and then use deep learning to create a psychopathic model, allowing customers' respond participating in counseling can be analyzed automatically. The final goal of this research is to supplement the accuracy of diagnosis through human counselors, and if data are accumulated enough to increase the accuracy of diagnosis, it will be able to carry out diagnosis service on AI alone except for human counselors.

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