Prototype Development for AI-based Disaster Response System

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1. Introduction

Recently, Disasters combined with natural and social causes have increased rapidly due to the complexity of social structures and climate change, and the scale of them is also increasing[1].

In particular, as can be seen from the Fukushima NPP accident, when a complex disaster occurs, enormous economic and social damage occurs due to limitations of response capabilities.

Therefore, there is an increasing public demand to prevent accidents in advance and protect lives and property with the best initial response in the event of an accident. To this end, the government has 41 standard manuals, 397 working-level manuals and 9,308 on-site action manuals in the form of standard operation procedures[2].

However, it is very difficult to memorize thousands of procedures or correlate the continuity of numerous environmental changes with the advantages and disadvantages of past experiences to analyze humans and derive optimal risk management and accident response procedures in a short time[3].

Due to the development of the 4th industrial revolution (AI, IoT, etc.), artificial intelligence(AI) technology has emerged as a powerful tool to solve the current problems, and various technologies are being developed in the disaster field. The technology will sufficiently serve as a specialized advisor to provide guidance on risk management and emergency response by analyzing based on vast amounts of data.

In this study, the possibility of developing an AI-based disaster response system was verified through a prototype.

2. Methods and Results

2.1 System Configuration

The prototype model implemented in this study consists of speech recognition, AI search, and information provision steps by searching for information matching the question among the data learned through speech recognition and providing procedures (guides) for emergency response with voice and screen. The system configuration diagram is represented in Fig.1.

2.2 Speech Recognition

STT (Speech To Text) refers to a function that a computer recognizes a person's spoken speech language, interprets speech, and converts its content into text[4]. It is also called Speech Recognition. This feature has many advantages for application of voice-based user interfaces over touch (text)-based user interfaces. Since voice can be input at about 150 words per minute, it is more than three times faster than touch or text search (about 40 words per minute) and is most similar to human communication form (two-way)[5]. The comparison is represented in Table.I.

Table I: Comparison of UIs based on voice and touch

	Voice	Touch(Text)
Input Speed	150 words/min	40 words/min
Multitasking	Yes (handsfree)	No

This model performs the function of STT when a user requests a portion of disaster-related response data required by the system to quickly search for procedures necessary for response.

2.3 Search Engine Conceptual Design

A hybrid search engine (HSE) was designed to implement the system. HSE performs a combination of rule search, open QA, and crawling functions to improve accuracy over existing technologies.

It includes a traditional keyword-based information search that learns thousands of existing procedures for response in advance and provides appropriate data when information requests are received, and it also compares the similarity of sentences in natural language processing (NLP) to find appropriate answers. Furthermore, it has a function that can be quickly searched even if the accuracy is lowered by analyzing the speed, tremor, and decibel of the input voice condition.

Through these search methods, HSE can improve precision and reproduction rate by supplementing the shortcomings of existing individual search models through the hybrid method.

2.4 Information Provision

Results searched through the search engine go through the TTS process. First of all, string processing proceeds, and the input character data is analyzed in various ways such as spelling conversion, morpheme analysis, and parsing. After that, it moves on to the process of searching for a speech that matches text data. Finally, the speech language obtained by synthesizing the searched speech pieces in order is output to the system.

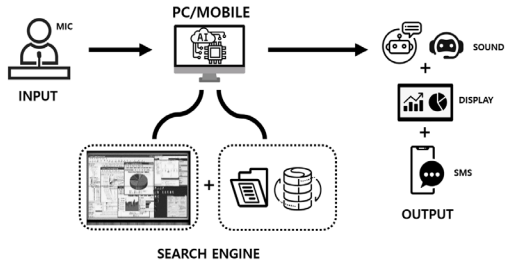

Fig. 1. System Configuration Diagram

3. Conclusions

As a result of implementing and verifying some functions, it was possible to extract the desired information without looking for procedures, and the results were provided on voice and screen, confirming that the understanding was much higher than reading the sentence. It also developed a conceptual design of a HSE optimized for disaster response while compensating for each shortcoming of existing information search systems.

This model presents an effective method to analyze a large amount of data in real time by implementing speech recognition and search engine as a preliminary step in developing an AI-based disaster response system, and lays the foundation for in-depth research such as development of an independent algorithm and NLP search system.

If a robust AI platform is established well through further research in the future, fundamental changes will occur in the disaster response process so far, and the ability to respond is expected to be strengthened.

REFERENCES

[1] Lee. D., Kim. S., Choi. I., Ki. G., The Role and Prospect of Smart Platform in Disaster Management. The korean Society of Disaster Information Conference(Nov.), pp.260-261, 2017.

[2] Lee. C., Park. G., Kim. T., Lee. H., A Study of the Situation Based Disaster Response Model from the Damage of Storm and Flood Field Manual. Journal of the Society of Disaster Information, V.15(No.4), pp. 617-625, 2019.

[3] Park. Y., Prevention-oriented Disaster Safety Management Using 4th Industrial Revolution Technology. Korea Institute of Industry(July Issue), pp.81-84, 2020.

[4] Min. S., Lee. K., Lee. D., Ryu. D., A Study on Quantitative Evaluation Method for STT Engine Accuracy based on Korean Characteristics. Journal of the Korea Academia-Industrial cooperation Society, V.21(No.7), pp.699-707, 2020.

[5] Choi. J., Lee. S., Status and Implications of the Voice Recognition AI Secretary Market. Information and Communication Broadcasting Policy, V.29-9(No.646), pp.1-37, 2017.