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A Study on Optimizing User-Centered Disaster and Safety Information Application Service

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Abstract

This paper emphasizes that information received in disaster situations can lead to disparities in the effectiveness of communication, potentially causing damage. As a result, there is a growing demand for disaster and safety information among citizens. A user-centered disaster and safety information application service is designed to address the rapid dissemination of disaster and safety-related information, bridge information gaps, and alleviate anxiety. Through the Open API (Open Application Programming Interface), we can obtain clear information about the weather, air quality, and guidelines for disaster-related actions. Using chatbots, we can provide users with information and support decision-making based on their queries and choices, utilizing cloud APIs, public data portal open APIs, and solution knowledge bases. Additionally, through Mashup techniques with the Google Maps API and Twitter API, we can extract various disaster-related information, such as the time and location of disaster occurrences, update this information in the disaster database, and share it with users.

Keywords: *Open API, Chat Bot, Mash up, DSS.*

1. INTRODUCTION

Disasters are emerging as a central risk to citizens in society. On July 15, 2023, the flooding of the Cheongju underground tunnel and the resulting damage to citizens due to heavy rainfall at the time was another incident caused by a lack of information [1][2]. This underscores the need for information to be rapidly disseminated to enable citizens to respond correctly and evacuate quickly in the event of a disaster [3]. Information received unilaterally from government agencies can vary depending on the media's communicative ability, leading to disparities in information. As a result, there is a growing demand among citizens for disaster and safety information. In addition, the results of the survey conducted by the Korea National Statistical Office regarding the ‘Perception of Social Safety’ show that 21.7% of the population feels that society is not safe, as depicted in Table 1. This means that at least one out of every five Korean citizens does not feel safe and experiences a

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sense of insecurity [4]. Moreover, the '2023 Disaster Management Assessment National Perception Survey' commissioned by the Ministry of Public Administration and Security was conducted through telephone interviews, including both landline and mobile phones, from March 2nd to 9th among a sample of 3,000 adults aged 19 and above. The safety perception scores varied by disaster or accident type, with the lowest score of 42.6 for fine dust and higher scores for frequent but more damaging types like fire and explosion at 60.4, forest fires at 61.8, and drought at 62.0. In terms of disaster management capacity, rapid information dissemination received the highest score of 62.3, indicating that it is considered the most critical aspect. Initial responses, such as life-saving measures, received a score of 58.5 [5]. These findings highlight the importance of disaster type identification, swift information dissemination, and the need for a decision support system in decision-making.

Table 1. Perception of Social Safety in 2022

Responses	in 2022
Safe	33.3%
Normal	45.0%
Unsafe	21.7%

To address these issues, this study focused on the need to identify disaster situations, prompt reporting, and the rapid dissemination of information. The study aimed to address the concerns of citizens about public safety and provide services and accessible information to facilitate decision-making in disaster situations, thus bridging the information gap for the benefit of citizens. In addition, a disaster and safety information application aimed at rapidly disseminating disaster-related information, bridging information gaps, and alleviating anxiety was designed. Its key features include the retrieval of weather, air quality, disaster action guidelines, safety maps, and other relevant information through an open API. Then, a chatbot system was implemented for automated responses, utilizing cloud APIs, open APIs, and knowledge bases to assist users in accessing information and making informed decisions. Additionally, mashup services were employed to extract various types of disaster-related information by integrating the Google Maps API and using the Twitter API. This data is regularly updated in the disaster database and shared with users.

The rest of this paper is organized as follows: Section 2 presents a discussion of related technologies, including open APIs and chatbots, as means to bridge the information gap and provide suggestions for their application. Section 3 details the user-centered disaster safety information application service. The specific details about the mashup service for extracting disaster data and its applications were outlined in this section. In Section 4, the operation process and functionalities were discussed. Finally, in Section 5, the study is concluded by discussing the expected impacts, trends, and challenges.

2. RELATED TECHNOLOGIES

2.1. OPEN API

The open API is primarily associated with the API for internet and communication network resources. Figure 1 illustrates the principle of an open API. In Korea, services using open APIs to open resources have become widespread, particularly among public agencies and portal sites [6]. As shown in Figure 1, it abstracts and standardizes the functionality to make resource usage open for resources that people collectively need to use. This allows various organizations to implement different outputs without the need for specialized

knowledge of the service resources.

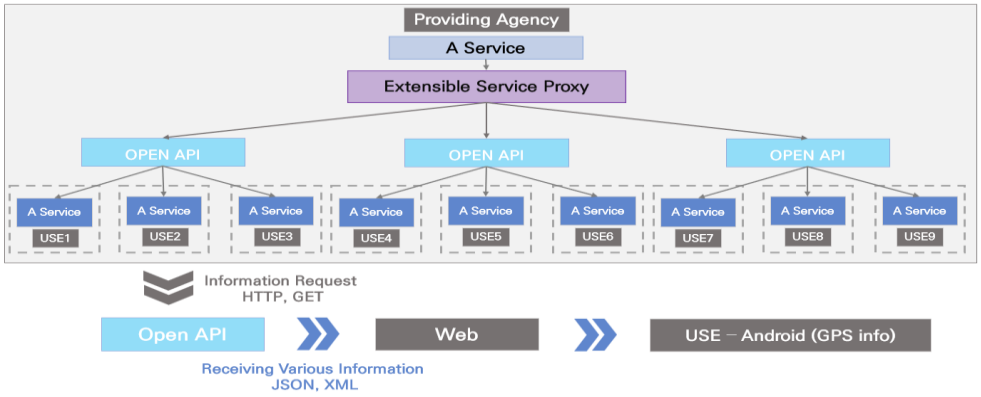

Figure 1. Open API

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Table 2. Natural Disaster Operation Specification

Operation Information	**Operation Number**	1		
	Operation Type	Query (List)	Operation Name	Guidelines for Civilian Actions in Natural Disasters
	Operation Description	This service allows the retrieval of a list of citizen action guidelines for natural disasters.		
	Call Back URL	N/A		
	Maximum Message Size	[10680bytes]		
	Average Response Time	0.35ms	Maximum Transactions Per Second	30tps
Call Message Information	Message Name	Behavior Conduct know How Natural Disaster List Service		
	Message Type	Variable Type		
	Preceding Operation	N/A		
Response Message Information	Message Name	Behavior Conduct know How Natural Disaster List Response		
	Message Type	List Type		
	Message Description	The service provides information on basic action guidelines that citizens should follow during natural disasters.		
HTTP Method		[O] REST (**GET**, POST, PUT, DELETE)		

Table 3. Parameter List

Parameter CODE	Parameter CODE Description
01001	Citizen Action Guidelines (Natural Disaster - Typhoon)
01002	Citizen Action Guidelines (Natural Disaster - Flood)
01003	Citizen Action Guidelines (Natural Disaster - Heavy Rain)
01004	Citizen Action Guidelines (Natural Disaster - Strong Wind)
01005	Citizen Action Guidelines (Natural Disaster - Heavy Snow)
01006	Citizen Action Guidelines (Natural Disaster - Cold Wave)
01007	Citizen Action Guidelines (Natural Disaster - Storm Surge)
01008	Citizen Action Guidelines (Natural Disaster - Yellow Dust)
01009	Citizen Action Guidelines (Natural Disaster - Heatwave)
01010	Citizen Action Guidelines (Natural Disaster - Drought)
01011	Citizen Action Guidelines (Natural Disaster - Earthquake)
01012	Citizen Action Guidelines (Natural Disaster - Earthquake and Tsunami)
01013	Citizen Action Guidelines (Natural Disaster - Tsunami)
01014	Citizen Action Guidelines (Natural Disaster - Landslide)
01015	Citizen Action Guidelines (Natural Disaster - Volcanic Eruption)

To implement the application, various necessary information, such as weather and guidelines for actions, must be utilized through public data. You need to access the data portal to obtain approval for information provision and obtain an API key. In this paper, the author used the "Ministry of the Interior and Safety - Citizens' Action Guidelines" service provided by the data portal. For implementation in an Android application, you can find guidance provided by the respective open API data. The natural disaster operation specifications are depicted in Table 2, and the parameter lists provided in the guide are shown in Table 3 [7]. Each of the parameter codes indicates a specific citizen action guideline; for example, the code 01001 provides the guidelines for citizen actions in case of the occurrence of typhoons, the code 01002 provides the guidelines for citizen actions in case of the occurrence of floods, etc.

2.2. CHATBOT

The system designed to provide a Decision Support System (DSS) for the chatbot operates within the application, where users input questions to the chatbot and responses are generated internally. Figure 2 illustrates the process of the chatbot service. This system is structured with an engine responsible for understanding questions and transmitting the appropriate data. Using this approach, the chatbot system is established within the application. As depicted in Figure 2, when a user inputs text into the chatbot, it is converted into JavaScript Object Notation (JSON) to create a request.

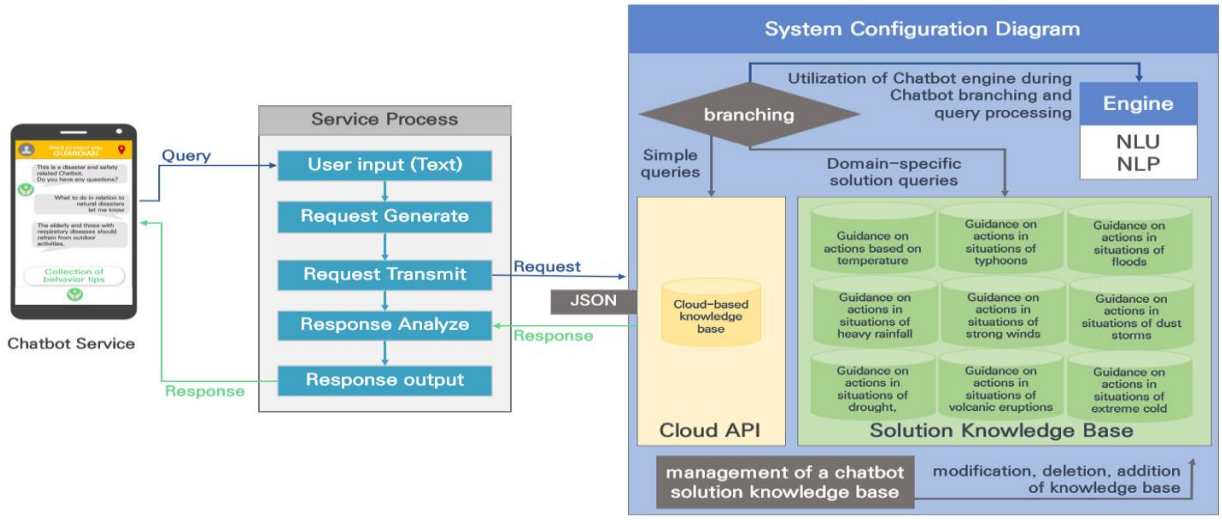

Figure 2. Chatbot Service Process

The request is then sent to the chatbot engine. Subsequently, the chatbot engine delivers a response in JSON format, which is then passed to the processing step for analysis and, finally, displayed on the chatbot interface. By implementing this system, the chatbot can be introduced into applications to assist in disaster and safety-related decision-making. The chatbot engine is built on two approaches. Firstly, for simple decision-making, utilizing a cloud-based chatbot API service provided free of charge is a convenient option. For straightforward conversations, this approach involves fetching the queries and responses of the chatbot system from a database, making it easy to set up and resolve usage issues efficiently. Secondly, a solution knowledge base will be constructed within the chatbot engine. The significant advantage of this approach lies in creating a knowledge base for the chatbot engine. The most time-consuming and effort-intensive stage in the system implementation process is constructing the conversation scenarios, where various conversation content needs to be machine-learned [8]. By registering these scenarios and training them in advance, you can provide users with expert-level question-and-answer capabilities. For simple decision-making, responses will be provided through a cloud-based chatbot API service. However, for situations that require more specialized information, a solution knowledge base will be constructed to provide expert-level guidance.

3. THE USER-CENTERED DISASTER SAFETY INFORMATION SERVICE

3.1. UTILIZING MASH UP IN DISASTER MANAGEMENT

Mashup refers to the creation of entirely new services by combining various open APIs. In the process of utilizing open APIs, the necessary web application is a web application that can provide services by mashing up various open APIs. Here, by using formats such as Really Simple Syndication (RSS), or Rich Site Summary based on eXtensible Markup Language (XML), and Geographical Really Simple Syndication (GeoRSS), which describes location information in RSS feeds using formats like Geography Markup Language (GML), users can automatically update their registered locations [9]. To design the application, you can combine Google Maps API's GeoRSS data format with the previously explained web application. This paper aims to utilize the previously explained mashup method and the Google Maps API to extract and utilize various disaster information, such as the time and location of disasters, which was previously accessible only unidirectionally through Social Networking Services (SNS). Figure 3 illustrates the mashup service process. Twitter supports developers to programmatically access data through the Twitter API, allowing developers to

use public tweets and replies. By leveraging this approach, real-time data is drawn and updated in the disaster database, as depicted in Figure 3, and shared with users.

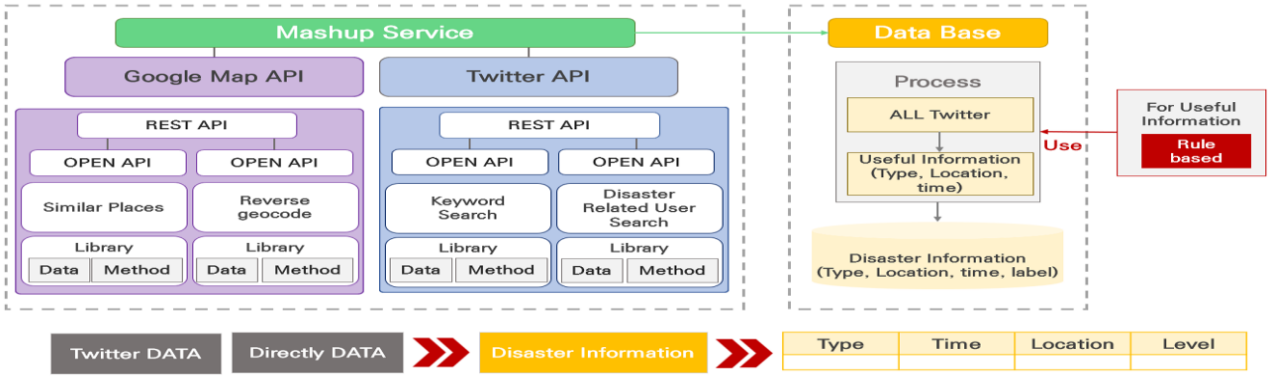

Figure 3. Mash up Service Process

In addition, a disaster database is constructed by using search APIs for disaster-related Twitter searches and location-related APIs. The method used is keyword search, and the keywords are based on relevant terms mentioned in the standard classification system for disasters. In South Korea, the ministry of public administration and security has classified disasters into 11 categories in the "Disaster Response Manual (2000)," including typhoons, floods, heavy rains, storms, tsunamis, heavy snowfall, earthquakes, droughts, cold waves, hailstorms, and crop/pest damage. Keywords based on this classification system are used for searching [10]. By using these keywords, disaster-related messages are filtered, and filtered tweets are utilized to extract disaster data related to the specific disaster that occurred at that time.

Table 4. Data Label

Classification	Criteria
Safe	0
Caution	1
Danger	2

Disaster data includes a column for the severity of the disaster, such as Table 4, which is classified into three categories: safe, caution, and danger. These categories are labeled with values 0, 1, and 2, respectively. This classification allows for more specific and necessary tweets to be filtered. The filtered Twitter messages, along with information directly reported by citizens through the application, contribute to the construction of disaster data. The columns that make up disaster data, as defined in this study, include disaster type, location, and severity. The disaster type, time, location, and severity are filled with label values based on the criteria for disaster severity defined in this paper. The Google Maps API will be used to visually represent the disaster-related tweets obtained through keyword searches, making it easy to understand the disaster data each tweet carries. The Google Maps API will be used to display markers on the map at the locations of disaster occurrences and to design a functionality that presents the collected disaster information on the map for the benefit of users.

3.2. THE UDSI APPLICATION SERVICE

This section offers a comprehensive explanation of how the User-Centric Disaster Safety Information (UDSI) Application Service operates.

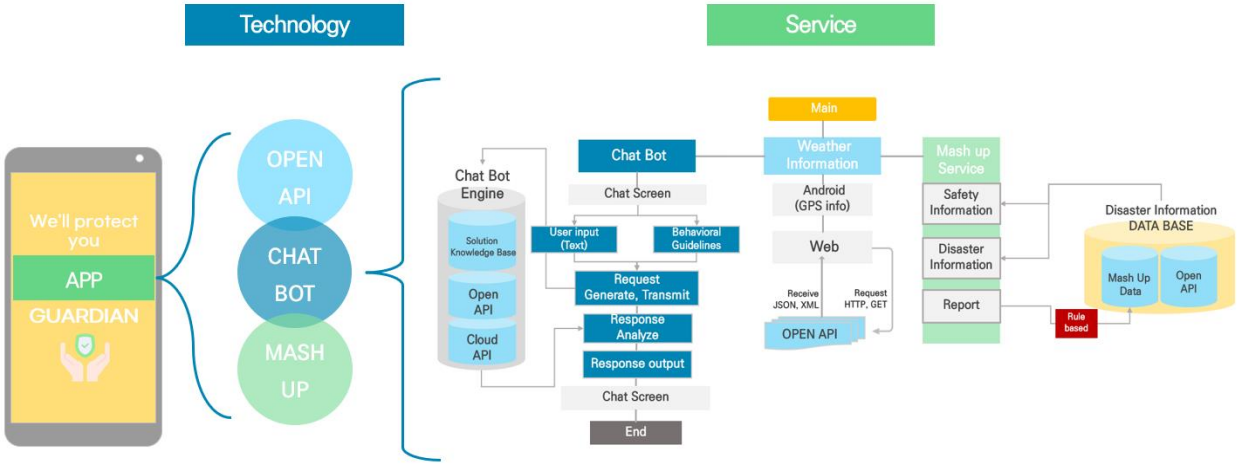

Figure 4. Service Architecture

Figure 4 illustrates the service architecture. In the initial stages, users are presented with options on the main screen, allowing them to choose between the chatbot, weather information, and Mashup services. A detailed description of the operational process is provided in section 4. The foundational structure of the User-Centric Disaster Safety Information Application Service revolves around a multifaceted approach. It integrates various application programming interfaces, directly collected databases pertaining to disaster-related information, solution knowledge bases, and other relevant data sources. This amalgamation of resources serves a paramount purpose: to diminish information disparities among users. The overarching goal is to provide users with not only consistent but also valuable and relevant information. By orchestrating this comprehensive system, the UDSI service aims to ensure that individuals facing disaster situations can access real-time and accurate information. This user-centric approach emphasizes the significance of delivering reliable data to users, ultimately contributing to effective decision-making and response strategies.

4. DISCUSSION

This section provides a discussion of the operational process and functionalities of the User-Centric Disaster Safety Information Application Service.

4.1. Weather Information and Chatbot Service

One of the functionalities introduced in this study is the utilization of the open API as part of the UDSI Service. The design aims to enable real-time checking and searching of air pollution and weather information provided by the public data portal. It is intended to retrieve data using the public data portal API from the Korea Meteorological Administration and implement it as succinctly as possible through Android Studio. By obtaining an API key and following the guidelines provided by the open API provider for application implementation on Android, we intend to reference and send the requested data, configuring the weather information inquiry service on the web in JSON and XML formats in a Uniform Resource Locator (URL)

form.

Another UDSI service functionality proposed in this study, the chatbot system, is established to provide chatbot services in the application for delivering a DSS. It plays a role in converting user-entered text into JSON format to create a request. Subsequently, it calls the chatbot engine, applying suitable APIs or a solution knowledge base, to generate responses based on the chatbot engine's response. The system then delivers the answers to the chatbot screen.

4.2. Disaster Database through Mash up Service

Moreover, another functionality proposed in this study for the UDSI service is the utilization of the mashup service. It uses the Google maps API and Twitter API methods. This is intended to enable real-time data visualization on the map with markers, allowing users to check information. The implementation aims to parse and display existing safety map information using an open API. When updating the database, the rule base ensures that the data being updated is represented as a combination of rules constructed for the set of facts in the antecedent part. These rules follow a structure where if the conditions specified in the antecedent part are satisfied [11], the consequent part is executed, allowing the data to be updated in the disaster database and shared with users.

5. CONCLUSION

The design of the disaster safety information application service presented in this paper was conceived to address the rapid delivery of disaster-related information, mitigate information disparities, and provide a solution for citizens' anxiety problems. However, it is not limited to these aspects and is expected to flourish as an application that offers disaster and safety information for diverse citizens, regardless of information disparities. This application is designed to provide individuals with a decision support system through Chatbot, enabling them to make informed decisions, evacuate, and respond appropriately, thereby minimizing information disparities. One limitation of this study is that, since the application design has been completed, the final implementation and its results and evaluation have not been described. This is a limitation that will be addressed through subsequent research after the implementation is finalized.

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