Infectious disease infection index information system

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Abstract-- **Various infectious disease information systems have been developed to provide infectious disease outbreak information through personal devices. However, the existing systems deliver information in the form of e-mail or text file, so it is difficult to understand at a glance. Additionally, users are unable to confirm the risk level because they are only provided with the number of outbreaks. In this paper, we propose a system that provides not only infectious disease outbreak but also relevant infection index information. We believe that our system provides effective infectious disease outbreak information by showing the user the risk level at a glance.**

I. INTRODUCTION

As the medical industry grows, it is moving to combine with Information and Communications Technologies (ICT) for more convenient medical services. As a result, with the proliferation of personal devices, smart health has emerged to provide medical information through smart devices, such as mobile phones. Since 2012, the spread of MERS continued in the Middle East region until 2015. From 2015~2016, zika virus broke out and led to widespread fatalities. The 2016 measles outbreak in Romania continues to spread throughout Europe. Furthermore, during the 2017 Winter Olympic Games in PyeongChang, Norovirus outbreaks caused worldwide fear. Due to continuing infectious disease outbreaks, People want to be able to receive infectious disease outbreak information through their personal device anytime, anywhere. So there have been many recent attempts to combat transmission by creating awareness through smart health.

Due to the seriousness of the damage caused by infectious disease, many researchers have conducted research on infectious disease information systems [1], [2]. Some systems provide infectious disease outbreak statistics in various file formats such as Comma-Separated Values (CSV) files that users can download [3], [4]. Some of those systems provide charts for infectious disease outbreak statistics [5], [6], [7]. Other systems provide information through e-mail [8], [9], [10]. Some systems send emails to users in the form of text, which include infectious disease outbreak information such as name of the area where it broke out. The number of systems providing infectious disease outbreak information has been increasing, but they are difficult to transfer information due to lack of visualized data. Therefore, it is not easy for the users to grasp the information at a glance. Additionally, most systems simply provide the number of infectious disease outbreaks, which is not easy to ascertain the level of risk because the risk level is relative to other factors such as population. Many infectious disease occurred in some area, but there may be relatively much more populations in the area. Therefore, the area may not be risky. Conversely, fewer infectious disease occurred in the other area, but there may be relatively much fewer populations in the area. Therefore, the area may be risky.

In this paper, we present a novel and very effective system that presents concise, relevant infection outbreak information and index to the user at a glance. First, the system collects and uses infectious disease outbreak data from Korea Centers for Disease Control & Prevention (KCDC). It provides users with search parameters such as time and district and presents infectious disease outbreak information based on their query. The system allows the user to receive the information on their personal device without time and space limitations. Users can view the information at a glance through maps and charts. The system also provide infectious indexes, which are numbers relative to populations, which helps users to more easily identify the regional risk level. Our system is now available on the web through http://www.epidemic.co.kr/map.

II. INFECTION INDEX INFORMATION SYSTEM

In this section, we describe the structure and flow of our system and introduce the development environment and language used for its implementation. Our system uses data collected from KCDC [11] to provide infectious disease outbreak information. Fig.1 shows the overall system architecture. Our system consists of user device, web server, application server, and database (DB). We equip the user device with an interface developed in HTML [12] and CSS [13], and use jQuery [14] AJAX [15] methods to send data. On the server side, we implement the system in a Java environment using Jetty as a web server and Spring Framework [16] as an application server. Spring Framework is an open-source framework supporting Java. The database stores or loads data into each table through the PostgreSQL [17] system. TABLE I describes the tables in our database. The working process of our system is as follows. (1) The user enters search keywords into the search form of the user device interface. The front-end sends search results requests with the form data. (2) The web server receives the request and transfers it to the application server. (3) The application server

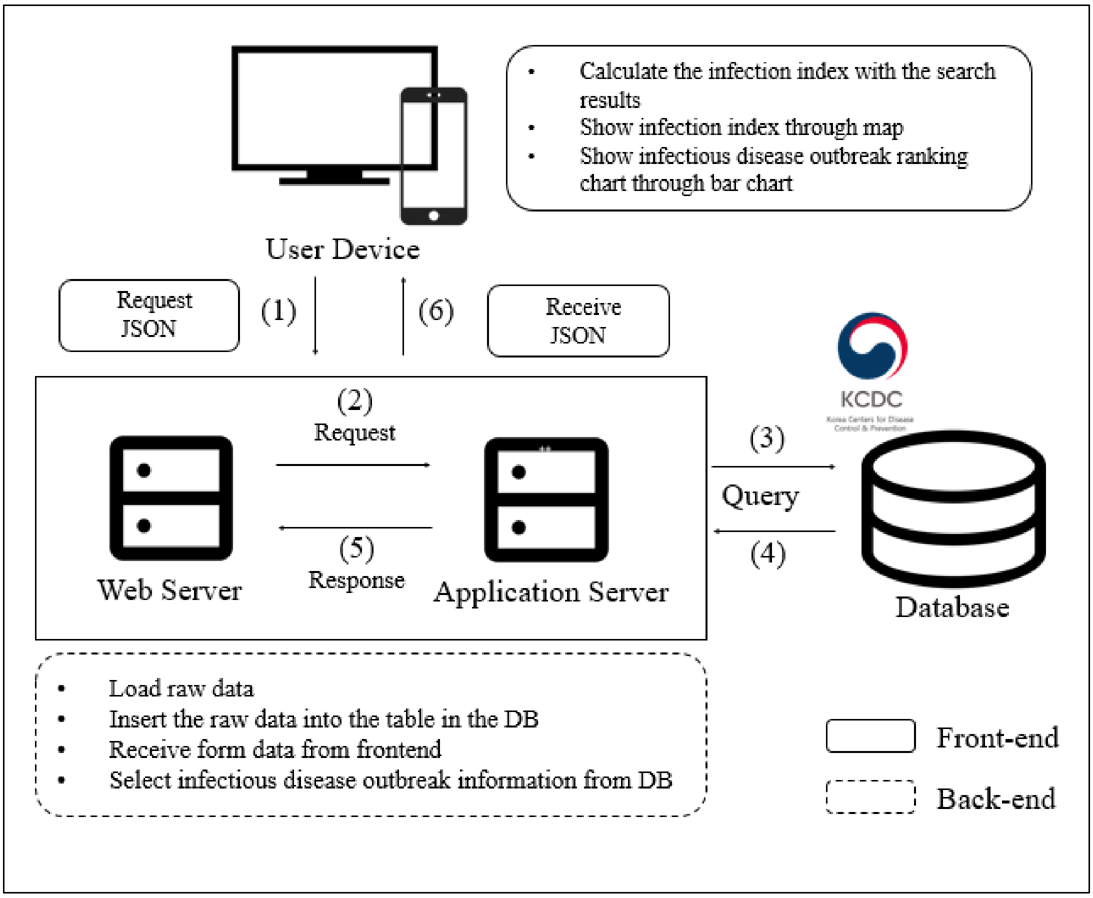

Fig. 1. System Architecture

TABLE I
DETAILED DESCRIPTION OF THE TABLES

Table	Detail
epidemic_tbl	Number of infected people by each infectious disease and district
population_tbl	Current population of Korea
si_code_vw	Si-code, unit of Si (district information)
sigungu_code_vw	Sigungu-code, unit of Sigungu (district information)
latlng_tbl	Latitude and longitude of each district

generates a query for the corresponding data from the DB. Fig.2 shows an example of query for infectious disease outbreak information to calculate infection index by referring to TABLE II. TABLE II describes the infection index provided by our system and contain the infection index formula. (4) The DB executes the requested query and passes the results to the application server. (5) The application server sends the query results to the web server. Finally, (6) the front-end fetches the query results in JSON.

Our system then produces visuals with the query results. First, our system uses Chart.js [18] (an open-source library that provides various functions for drawing charts) to display the resulting infectious disease outbreak ranking as a bar chart. The system inserts each value fetched from the query result into an infection index calculation formula and displays the result. Our system provides not only the number

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SQL Function : indexByDistrict(parameters)
Input Parameters (int v_year, int v_month, int p_year, int p_month,
          varchar v_epidemicId, varchar v_addressId)

SELECT et.total AS currentTotal,

(SELECT total  FROM epidemic_tbl
WHERE addressId = v_addressId AND year = p_year AND
  month = p_month AND epidemicid = v_epidemicId) AS previousTotal,

(SELECT sum(total) FROM epidemic_tbl
WHERE year = v_year AND month = v_month AND
  epidemicid = v_epidemicId) AS nationTotal,

(SELECT total FROM population_tbl
WHERE year = v_year AND month = v_month AND
addressid = substring(v_addressId, 0, 3)) AS upperTotal,

pt.total AS districtTotal

FROM population_tbl AS pt , epidemic_tbl AS et
WHERE pt.addressid = v_addressid AND pt.addressid = et.addressid AND
et.year = v_year AND et.month = v_month AND
epidemicid = v_epidemicId AND pt.year = v_year AND pt.month = v_month;
```

Fig. 2. Query for selecting infectious disease outbreak information

of outbreaks that is, the total number of infected people but also four infection indexes based on time and district-related infectious disease outbreak data. To be more specific, our system calculates the infection index and provides it to the users by using the number of infected people in one district, the number of infected people in the upper district, the number of people infected last month., the population of the district, the number of infected people of nationwide.

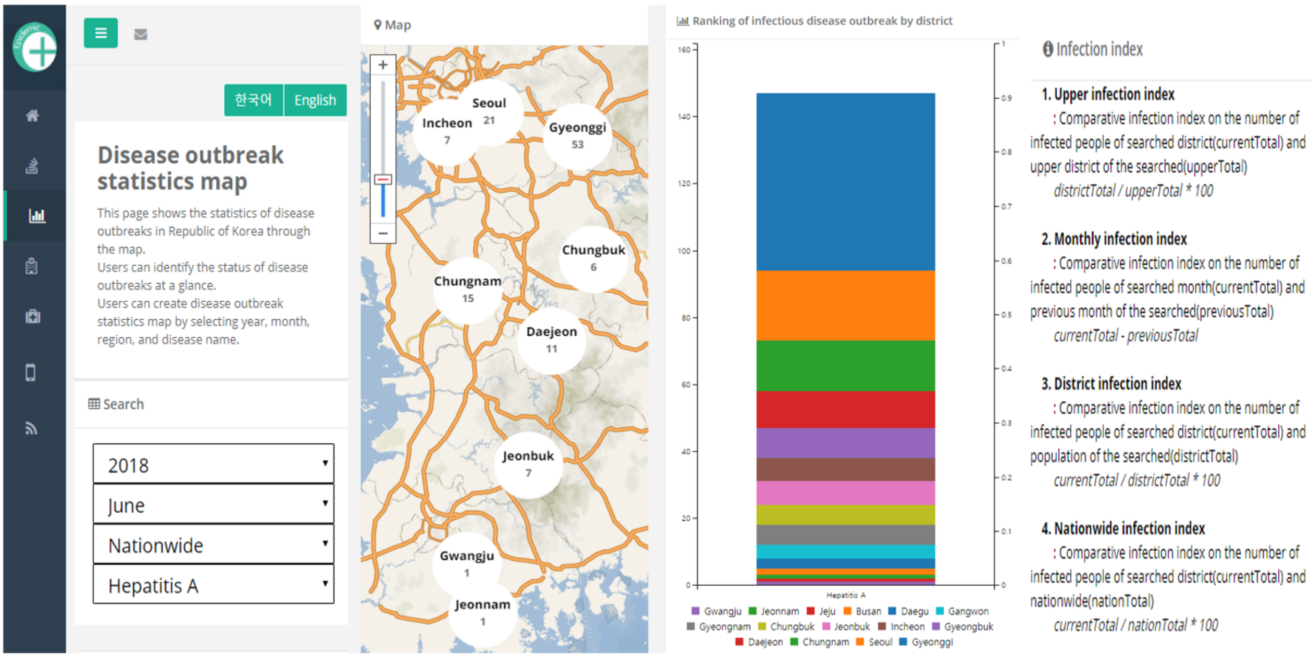


Fig. 3. User interface in mobile environment

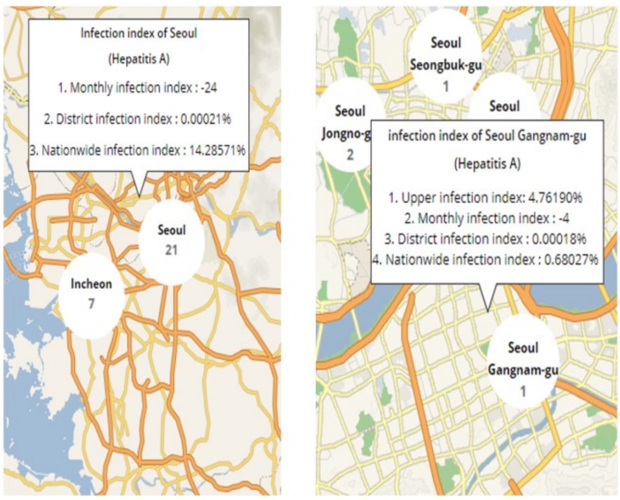
TABLE II
DETAILED DESCRIPTION OF THE INFECTION INDEX

Infection index	Detail
currentTotal	The number of infected people that users searched : date, district, infectious disease
Upper infection index	Comparative infection index on the number of infected people of searched district(currentTotal) and upper district of the searched(upperTotal) (districtTotal / upperTotal) * 100
Monthly infection index	Comparative infection index on the number of infected people of searched month(currentTotal) and previous month of the searched(previousTotal) currentTotal - previousTotal
District infection index	Comparative infection index on the number of infected people of searched district(currentTotal) and population of the searched(districtTotal) (currentTotal / districtTotal) * 100
Nationwide infection index	Comparative infection index on the number of infected people of searched district(currentTotal) and nationwide(nationTotal) (currentTotal / nationTotal) * 100

Our system implements a visual layout displaying the map and infection index information using NAVER Map API [19]. NAVER Map API is an open platform that implements maps by providing various functions and classes to applications, such as web and mobile.

III. RESULTS

In this section, we discuss the results of our proposed system. Fig.3 shows the user interface in the mobile environment. The user interface of our system provides a form to input four search parameters: year, month, district, and infectious disease name.



(a) Nationwide (b) Seoul

Fig. 4. Infection index information by district

According to the search keywords entered by the user, our system displays the infectious disease outbreak information along with a ranking of the infectious disease outbreaks by district in chart form. Finally, the system presents the user with a guide to the infection index: upper infection index, monthly infection index, district infection index, nationwide infection index. Fig.4 shows infection index information according to a user search. First, Fig.4(a) shows the infection index information of hepatitis A, nationwide, in June 2018. Fig.4(a) shows the information of Seoul, one of the nationwide sub-districts. Since the upper district is nationwide, upper infection index and nationwide infection index are the same in the national search, and upper infection index is excluded from the infection index. The figure shows that the number of infections in Seoul and Incheon in June 2018 is 21 and 7, respectively, indicating that the number of infections in Seoul is three times that in Incheon. The risk of hepatitis A infection in Seoul is high. However, when we check the infection index information, Seoul had fewer than 24 outbreaks, compared to last month. And the district infection index of Seoul is 0.00021%. This infection index indicates that the number of people infected with hepatitis A in Seoul is very small compared to the population. In other word, the information means that the risk level is not very high.

Fig.4(b) shows the infection index information of hepatitis A, in Seoul, in June 2018. Fig.4(b) shows the four infection indexes described above of Gangnam-gu—one of the Seoul sub-districts. The number of outbreaks in Gangnam-gu in Seoul is 1. With the information, we can think that the risk level of Gangnam-gu is low. However, when we look at the infection index information, upper infection index is 4.76190%. There is one outbreak, but upper infection index is big. Seoul has many sub-regions, so even if one person takes hepatitis A, the risk level may increase.

Fig.4 shows that the number of infectious disease outbreak is relative through the figure. However, if we check with the infection index information, we can identify the exact risk level of infection.

IV. CONCLUSION

Recently, as anxiety due to the spread of infectious diseases continues to increase, so does the need for an improved infectious disease outbreak information system. Existing systems lack visual data, making it difficult for users to identify information at a glance. Additionally, the systems provide only the number of outbreaks, so it is not easy to determine the level of risk. In this paper, we propose an infectious disease outbreak information system that shows relative infection index information in the form of maps and charts for clear visualization. We describe the architecture and user interface of our system, and the infection index. Using their personal devices, users can conveniently view infectious disease information through a search of date, district, and infectious disease name. Furthermore, the infection index we provide allows the users to quickly and easily identify the risk level of infectious diseases. We believe that our system helps people obtain clear and concise infectious disease outbreak information. Our system is now alive on the web through http://www.epidemic.co.kr /map.

ACKNOWLEDGMENT

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