Family Information Sharing System using an Access Control Method which depends on the Situation based on a Judgement of Emergency

Yuka Hasegawa
Ochanomizu University
Bunkyo, Tokyo, Japan
Email: hasegawa.yuka@is.ocha.ac.jp

Masato Oguchi
Ochanomizu University
Bunkyo, Tokyo, Japan
Email: oguchi@computer.org

***Abstract*—It might be greatly helpful if you can share life logs between family members when a disaster occurs, from aspects of confirming safeties and searching them. However it would be a serious problem if you can see the personal information all the time without the permission of the person himself. In this paper, we propose the access control method that can change the access privilege depends on the real world situation. In the proposed method, external and internal information is used to judge whether the given situation is emergent or not. We developed a Family Information Sharing System(FISS) as a example using that access control method and will introduce the system in this paper.**

I. Introduction

Confirming family member's safety - it comes into minds of many people in case of emergency such as the Great East Japan Earthquake in 2011. However it is difficult to get in touch with family members by phone or e-mail because of network congestions. In the research of the Great East Japan Earthquake[2], 80% of survey objects answered that they couldn't make phone call and 80% of them felt uneasy because they couldn't know the safety of family members. It is suspected that the clues of family member's safety are useful in the situation that they cannot contact to their family directly.

Therefore, the system which stores life logs at normal times and shares the life logs among the family in an emergency is helpful. By using that system, users can get data from the server and comprehend family's situation even in the case which the users in the disaster area cannotcannot react through phone or e-mail.

However, a privacy protection must be considered in such systems. The life logs must be accessible from other users only in case of emergency. Therefore, it can be said that an access control method which reflect the real world situation is needed. In this study, we propose the system which judges the given situation is emergent or not from several information sources and control the access permissions of the life logs.

The present paper describes the outline of the system, the functions of it and how the functions are used for access control. After that, we describe how the system is implemented closely.

II. An Information Sharing System between Family Members

A. Outline

We developed FISS(Family Information Sharing System) which is for information sharing in case of emergency. Figure 1 shows its structure chart.

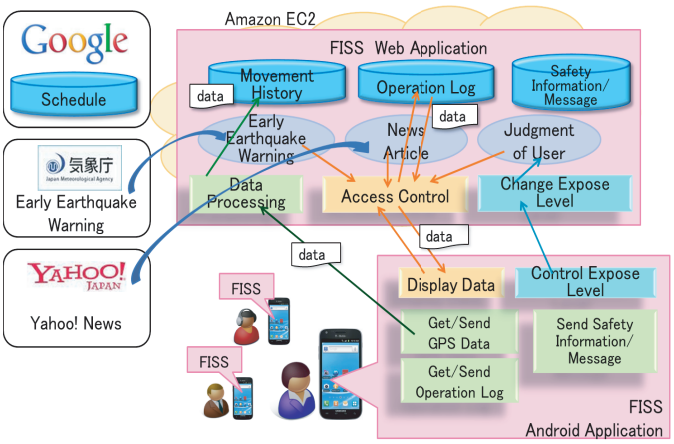

Fig. 1. Structure chart of FISS

FISS is implemented separately into server-side and client-side. On server-side, a web application is implemented on Amazon EC2, a general-purpose cloud service. On client-side, an Android application works on Android devices. FISS users use the system via this Application.

B. Functions of FISS

We explain four main functions of FISS.

1) Store Life logs: The first function of FISS is storing life logs. These life logs are used to identify the whereabouts and check the safety of family members when you no longer get in touch with them. Though many kinds of life logs can be put in count, movement logs, operation logs of Android devices and schedule are used in FISS, as one example. These life logs can be strong clues to know where the user was, until when the user could operate the device, what the user was doing and with who the user was. Furthermore, when a disaster occurs,

FISS confirms whether users are safe or not by urging response from them on Android Application. If they react it, FISS stores the responses.

Movement logs and operation logs are acquired by FISS Android Application. Movement logs are acquired using GPS function of Android devices and sent to server regularly. When the user operate the Android device, FISS Android application detects the operation and send the data what kind of operation is done regularly. FISS gets Google Calendar data as schedule using ”Calendar API”[4] supported by Google Inc. Each user delegate access privilege of Google Calendar to FISS by using OAuth beforehand. Then FISS can get data from Google Calendar without saving user ID and password inside the system.

2) Obtain External Information: The second function of FISS is obtaining information which can be used to judge current situation is emergent or not,judgement from outside of the system. The judgement is made by using several information due to achieve high trusted access control. Though there are some kinds of information useful for the purpose, we focused on earthquake and used Early Earthquake Warning(EEW) and News articles on websites. These details will be mentioned afterwards.

3) Process Internal Information: The third function of FISS is processing internal information of the system which is obtained when users operate Android Application, in order to use for the emergency judgement and the access control. ”Operate Android Application” indicates that users send a request to see life logs of their own family members. Though these requests can be a source of the emergency decision, if the system always allows to show life logs when it receives a request, the privacies would be not protected. To avoid that situation, the request data must be used under some kind of control methods, not directly. In this letter, we propose two methods, ”Hierarchical Mutual Authentication” and ”judgement from Request Ratio of Nearby Users”. FISS uses these two methods jointly.

4) Emergency judgement and Access Control: The forth function of FISS is make the emergent judgement and do the access control using external information mentioned as the first and the third function and internal information mentioned as the second function. ”Access Control” includes the control that manages which life log to be shown to the users, not only decides to show or not. To be more specific, FISS makes the emergency judgement by using the external information (EEW and Yahoo! News articles) and the internal information (Request Ratio of Nearby Users and Existence of Safe Message from Users) and decides which life log to be shown by using ”Hierarchical Mutual Authentication”.

III. Emergency Judgement and Access Control

In this chapter, we explain details of the emergency judgement and the access control. In Figure 2, a flow of processing is shown.

When FISS receives a request to see a user’s life log, for the first step, FISS judges whether the user is in the dangerous area or not using EEW, news articles or the request ratio of nearby users. We define ”dangerous area” as the area the disaster

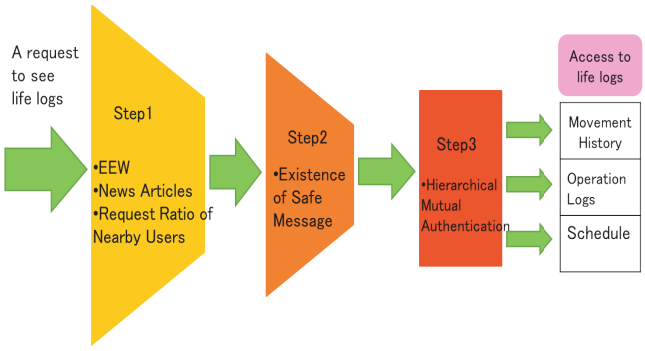

Fig. 2. Flow of Emergency judgement and Access Control

affects seriously. For the second step, if the user is in that area, FISS checks whether the user sent safety information and a message to the system or not. If the user haven’t answered, the family member can reach to the user’s life logs. However even in that situation, the user may not have affected by the disaster and possibly just haven’t noticed. Therefore it is not adequate to show all life logs to the family members in that time. For the third step, FISS uses ”Hierarchical Mutual Authentication”. By using it, FISS avoids to show life logs needlessly and achieves graded access control.

IV. Utilization of External Information

In Figure 3, a flow of obtaining the external information and confirming the user’s safety is shown.

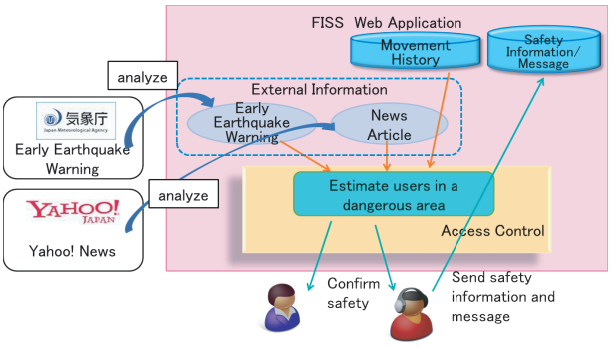

Fig. 3. Flow of Obtaining the External Information and Confirming the User’s Safety

EEW’s purpose is warning people before the earthquake waves reach. For that reason, EEW is issued immediately when observation equipments detect a earthquake. On the other hand, news articles inform users details and damages of the earthquake afterwards. Because FISS confirms user’s safety on Android Application, it is desirable to find users in the dangerous area as early as possible. However the cases that EEW doesn’t issued or the scale of the earthquake is bigger than EEW informed may well happen. Therefore by using news articles together with EEW, FISS avoid to oversee users who are in the dangerous area.

A. Early Earthquake Warning

Early Earthquake Warning(EEW) is a warning issued just after an earthquake is detected in Japan . The warnings are

issued mainly by the Japan Meteorological Agency(JMA) and inform where the earthquake occurred and how strong it is. People can know an earthquake is coming before the wave of the earthquake reaches to own position. Normally you see EEW on television, radio or mobile phone.

To get EEW from JMA directly, a forecast business permission is essential and must have a juridical personality. FISS used EEW information via getting Tweet messages which are broadcasting EEW contents indirectly.

There are some accounts tweets EEW message on Twitter. In our system, we used ”Streaming API”[5] supported by Twitter Inc. and observing the stream of one of these accounts. This time we used a account ”@eewbot”, as one example. This account broadcasts EEW information in form of CSV. The position the earthquake occurs (longitude, latitude and depth) and strength(magnitude) of the earthquake can be gained from the Tweet. FISS calculate seismic intensity on each user’s position roughly. We used formulas introduced in [8] and [9] to predict the intensity.

B. News Article

Thus there are many news sites, for instance we decided to use Yahoo! News. Yahoo Japan is a portal website which is accessed the most in Japan. By using ”Topic Headline Archive API” supported by Yahoo! Japan, FISS gets titles of articles issued in ”Earthquake” category. FISS parses the title and extracts information of the earthquake such as the area the earthquake affects and the intensity. Because user’s locations are saved as latitude and longitude form, the area information extracted from news articles must be parsed to latitude and longitude range. Therefore FISS uses ”Geocoding API”[7] supported by Google Inc. The API returns latitude and longitude range equivalent of the area specified by GET request parameter. For example, if you send a request to the API with parameter ”Tokyo”, it returns each latitudes and longitudes for southwest corner and northeast corner of Tokyo. However this API doesn’t support wider area names such as ”Kanto” or ”Tohoku”, for example, FISS converts the area name to latitude and longitude inside of the system without Geocoding API.

It should be noted that the acquisition of the news article isn’t done in real-time. FISS sends request to Yahoo! API periodically and confirms whether the article about earthquake is issued or not because of the API’s spec. Hence it is impossible to detect emergency from Yahoo! News articles at the same moment to the article is issued.

C. Detect Emergency from External Information

Figure4 shows the data for about 4 weeks obtained by the method explained before. This graph shows the relation between EEW and Yahoo! News articles.

”Maximum Magnitude” means the maximum magnitude of the earthquakes occurs in that day. Hence EEW warned 76 earthquakes during the research term, Yahoo! News issued only two articles. These articles issued on February 1 and 2, once a day each. The earthquake occurred on February 2 in Hokkaido was relatively strong, intensity 5 upper, according to Yahoo! News. The magnitude was 6.5 according to EEW.

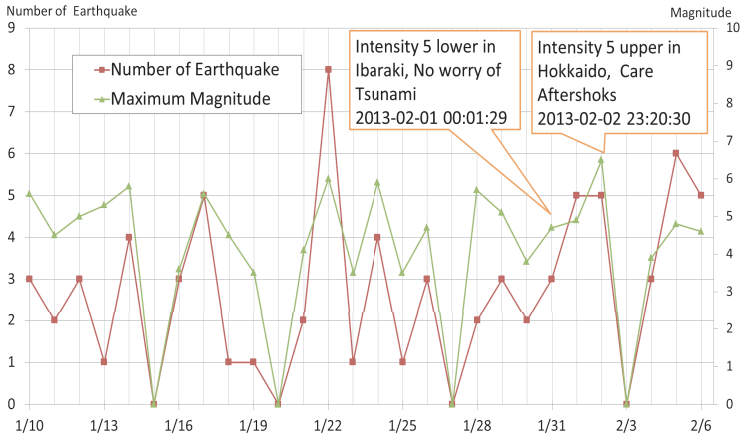

Fig. 4. Relation between EEW and Yahoo! News Article

Focusing on the article issued on February 1, it tells an intensity 5 lower earthquake occurred in Ibaraki just before the date changed. Thus the article was issued on February 1, the earthquake occurred January 31. FISS detected the earthquake from EEW at 23:53 on January 31, about 8 minutes before the article issued. Saying about the first article for the earthquake in Hokkaido, it was issued about 2 minutes after EEW was issued. To see these news articles, it is possible to get the accurate intensities and the situations of damage because there are written after the facts confirmed. However the promptness is weak and the timing of issue is different depends on the situations.

There are some strong earthquakes without news article. It is assumed that the earthquakes didn’t make damages to the area people living because these thaey occurred far from land. Therefore no articles were issued for these articles.

For the next, we tested FISS whether it judges a given situation is emergent or not, on the assumption that there are users in some place in Japan. In Figure5, it is displayed where the virtual users are. The users were placed in Hokkaido, Ibaraki and Tokyo.

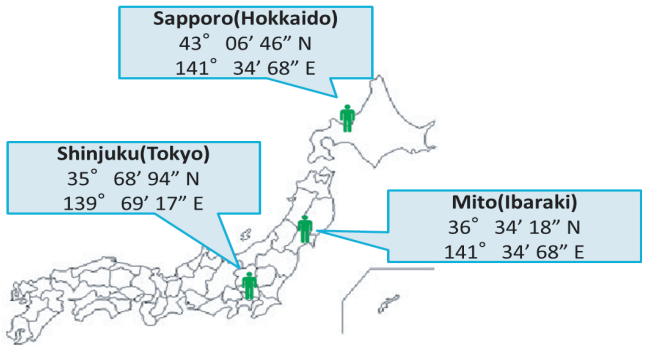

Fig. 5. Points the virtual users placed for a test

In Table I, the result of the earthquake occurred in Hokkaido, on February 2nd is shown. The earthquake occurred in 42 °6’ North Latitude and 143 °3’ East Longitude, depth 120km, magnitude 6.5. The intensities announced by the Japan

Meteorological Agency(JMA) later date were added to the table for a comparison.

TABLE I. EFFECT OF EARTHQUAKE OCCURRED ON FEBRUARY 2 IN HOKKAIDO

User's position	Intensity calculated from EEW	Yahoo! News	Intensity announced by JMA
Sapporo(Hokkaido)	3.3 ± 0.7	Inside of Dangerous Area (Intensity 5 upper)	3
Mito(Ibaraki)	0.5 ± 0.7	Outside of Dangerous Area	2
Shinjuku(Tokyo)	0.1 ± 0.7	Outside of Dangerous Area	1

In Table II, the result of the earthquake occurred in Ibaraki, on January 31 is shown. The earthquake occurred in 42 °6' North Latitude and 143 °3' East Longitude, depth 120km, magnitude 6.5.

TABLE II. EFFECT OF EARTHQUAKE OCCURRED ON JANUARY 31 IN IBARAKI

User's position	Intensity calculated from EEW	Yahoo! News	Intensity announced by JMA
Sapporo(Hokkaido)	-1.8 ± 0.7	Outside of Dangerous Area	none
Mito(Ibaraki)	2.5 ± 0.7	Inside of Dangerous Area (Intensity 5 upper)	2
Shinjuku(Tokyo)	1.3 ± 0.7	Outside of Dangerous Area	none

In the prediction of intensity using EEW, FISS calculated a larger intensity as nearer user from the place the earthquake occurred, therefore it is said that the results are reasonable. From news articles, FISS detected the users who are in the dangerous area correctly.

The intensity written in the news article are the maximum intensity in the area. For example, saying about the earthquake in Hokkaido, the intensity is in Tokachi(a place in Hokkaido). The actual intensity observed in Sapporo is 3 and it is predicted appropriately. In the case of the earthquake in Ibaraki, there are areas in one of them the intensity is 5 lower and in the other the intensity is 2. The reason is that the center of the earthquake is relatively shallow 10km depth and the waves didn't expand to large area, therefore in the small area the strong intensity was observed.

In the practical use phase of the system, a threshold against the calculated intensity should be prepared and when the calculated intensity exceeds the threshold, FISS should confirm the safety of users. However the accuracy of the intensity is not high and there is a probability that the actual intensity is much different from the calculated intensity. Therefore the threshold should be lower to avoid an oversight of emergent users.

From the above, it can be said the analysis of Yahoo! News articles and the intensity estimation using EEW are techniques can be used for emergency judgement, although there are some points to be considered. Furthermore, because each methods have advantages and disadvantages, it is presumed that the combination of these methods would be useful.

V. PROCESSING OF INTERNAL INFORMATION

As we discussed in Chapter 2, the requests to see a user's life log are processed by two methods, "Judgement from Request Ratio of Nearby Users" and "Hierarchical Mutual Authentication", and used for the emergency judgement and the access control.

A. Judgement from Request Ratio of Nearby Users

This method is based on the stance that the reliability of one person's judgement is low, however the reliability of many person's judgements is relatively high. In Figure 6, the concept image is shown. If you send a request to see User A's life log, the users nearby User A is searched and checked whether the users also received requests.

If the users nearby User A also received requests, it is thought that the area has high possibility to get damaged by the disaster by the family members of the users . Thereupon, User A is judged to be in a dangerous area.

The advantage of this method is that it is decided the life log will be shown or not objectively because it refers to the opinion of the third party not of the interested party. Although each user's opinion is used as information source, the situation whenever you want to see the life logs, you can see them is avoided.

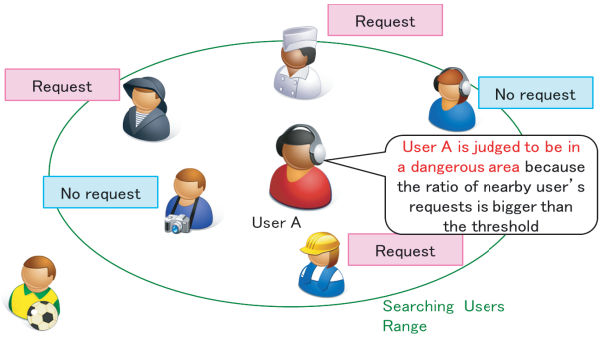

Fig. 6. Concept of judgement from Request Ratio of Nearby Users

B. Hierarchical Mutual Authentication

In this paper, the hierarchal mutual authentication is defined that each user is at a level and between same level users are authenticated mutually. Authenticated users can see adversary life logs. In Figure 7, the outline figure is shown.

Life logs are assigned to each level and at the level users can see correspond adversary life logs. All users are at Level 0 at the normal period. At that level, users cannot see any adversary life logs. Let's take a look how the mechanism works in case of emergency using a example that User B wants to see User A's operation logs. User B raises User A's level from 0 to 2, correspond to operation logs. At the same time, User B's level also raised to 2 automatically. User A and User B are now at the same level, they can see adversary life logs.

It works as a deterrence of seeing adversary life logs unduly that the level of the user who raised other user's level is raised forcibly. It means that if you want to see other user's life logs, you must show your life logs to them.

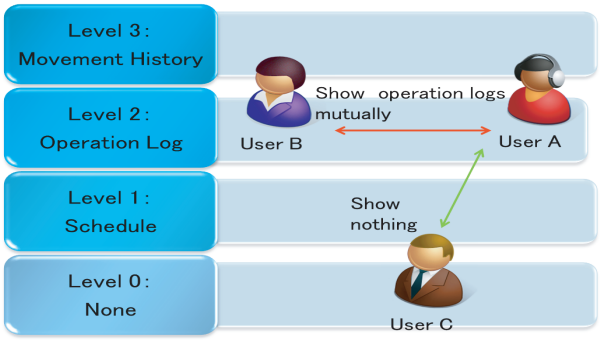

Fig. 7. Concept of Hierarchical Mutual Authentication

VI. Android Application

The implementation we explained before is on server-side. In this chapter, we explain about the FISS Android application, the user interface part of the system.

In Figure 8(a), the main page of FISS Android application is shown. Users check their own life logs from this page.

In Figure 8(b), the page confirming user's safety is shown. The safety of the user who is judged in a dangerous area on the server side, is confirmed by PUSH notification, using this page. PUSH notification is a mechanism to send data from the server to the client. Normally the server returns data only when the client requests, however by using PUSH notification, it is possible to send data to the client at any time from the server. To use the mechanism in Android, FISS is using the service "Google Cloud Messaging for Android"[10] supported by Google Inc.

In Figure 8(c), the page to check the information of the user whose safety is confirmed is shown. The safety information and message sent by the user are displayed. Because the safety of the user is confirmed, FISS understands the user is not in a dangerous situation and other users cannot change the user's level.

In Figure 8(d), the page to check the information of the user whose safety is not confirmed is shown. The user's level was changed to level 2. At this time, your level is also at 2 and your life logs are also to be seen by other users. You reaches this page in the situation that the user is judged to be in a dangerous area and the user don't answer the confirmation of safety, furthermore you want to see the user's life logs even you show your life logs to other users. FISS provides the mechanism to show the user's life logs to the family member after strict the access control.

VII. Conclusion

We proposed an access control method which the privilege changes depends on the real situation, and developed a Family Information Sharing System(FISS) using the method. It achieved to implement a system that you cannot see other user's life logs in normal period and only in case of emergency you can see the life logs.

(a) Main page

(b) Confirming user's safety

(c) Showing information whose safety is confirmed

(d) Showing information whose safety is not confirmed

Fig. 8. Android application screen shots

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