Development of "Aruite Mi Mai," A Walking Application for Crime Prevention for Safe and Secure City Development

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Abstract. To realize city development that allows people to live safely and securely, (1) citizens should have accurate perspectives on safety, (2) local stakeholders such as administrators, companies, and residents should share various kinds of risk information based on these perspectives, and (3) local stakeholders should create a safe community and tackle necessary problems. Therefore, we developed a mobile app to support users in learning perspectives on crime prevention through city patrol activities and in sharing the contents as risk information. In this paper, we discuss the usefulness of the app based on data from practical use and describe the prospects for supporting the formation of safe communities in the future.

Keywords: Safe and secure city development · Perspective · Crime prevention · Situational crime prevention theory · Information sharing · Community formation

1 Introduction

Japan frequently experiences natural disasters such as earthquakes, typhoons, torrential rains, flood and sediment disasters, tsunamis, volcanic eruptions, and blizzards. However, in addition to ensuring public safety and security on a daily basis through measures such as crime prevention and traffic safety, the need for a social system that guarantees safety and security has been recognized [1].

The Japanese Ministry of Land, Infrastructure and Transport [1] has noted the following: "To develop cities that allow people to live safely and securely, (1) citizens should have accurate perspectives on safety, (2) local stakeholders such as administrators, companies, and residents should share various kinds of risk information based on these perspectives, and (3) local stakeholders should build their community and tackle necessary problems."

In this paper, with the aim of promoting crime prevention during the development of safe and secure cities and communities [2], we devise a system that supports users in learning perspectives about crime prevention through city patrol activities by stakeholders such as local residents.

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As this research aims to involve a wide variety of age groups, from young people to the elderly, in crime prevention, this system is developed as a user-friendly mobile app for use on smartphones and tablets. In addition, we examine the usefulness of patrol activities for crime prevention, which involve walking around and therefore provide health benefits for users. With this background, and because a function for recording walking history is planned to be included in the app in the future, we decided to call this crime prevention walking app "Aruite Mi Mai" (which means "Let's walk" in the local Sanuki dialect of Kagawa Prefecture, Japan).

In this paper, we detail the design of risk information sharing and other functions for learning safety perspectives of crime prevention. Here we describe our newly developed app's home screen, usefulness (based on data from practical use). We conclude with a discussion of prospects for the development of a community formation support function.

2 App Design

2.1 Learning Perspectives from the Creation of a Regional Safety Map

Users of this app will carry out crime prevention patrol activities in their city to report on and share information about safe and dangerous locations. In this research, we utilized a regional safety map as a means of coordinating information recorded by individual users. A regional safety map shows photographs of places where crime is more likely to occur, with a location assessment ability (i.e., the ability to predict dangerous locations) that can be improved based on data from the user [3, 4]. Therefore, for our app, we developed a user interface (UI) that allows users to create regional safety maps.

An important aspect of this app is that it allows users to master the use of different perspectives on safety. In the process of creating a regional safety map, users not only judge whether a location is safe or dangerous, but they also explicitly evaluate the risks of that location based on correct perspectives. Therefore, our app incorporates reliable perspectives based on situational crime prevention theory [4, 5] that can be selected by users, as mentioned in Sect. 2.2.

2.2 Selection of Perspectives on Safety Within the App

To enable users to evaluate the risks of a location when reporting, the selection buttons in our app are labeled with keywords about perspectives on safety. When users share information about their perspectives, the keywords they select are tagged to their report, which can then be seen by other users.

Komiya argued that eliminating opportunities to commit crime is an optimal strategy for deterring crime, and proposed three elements of crime deterrence that allow anyone to practice the theory anytime, anywhere [4]. In addition, Komiya devised keywords that express perspectives and can be used by anyone, even elementary school students [5].

In this research, we use the keywords devised by Komiya [6] based on situational crime prevention theory [4]. Keywords for safe and dangerous locations are “easy to monitor” and “difficult to access”, and “easy to access” and “difficult to monitor”, respectively. “The location is easy/difficult to monitor” is a measure of monitoring ability by pedestrians or residents, and “easy/difficult to access” is a regional measure. For example, “difficult to access” means a lower likelihood of kidnapping because a car cannot easily access the location, or “easy to monitor” means a lower likelihood of mugging, etc. The app provides check boxes that enable users to select keywords after judging whether a location is safe or dangerous during patrol activities.

3 App Implementation

While our plans are for this app to eventually include a walking support function aimed at recruiting a wider range of users and supporting community formation, in this research we have implemented and evaluated only the most basic functions corresponding to the design described in the following sections. In this paper, we examine the effectiveness and usefulness of these functions using the implemented system.

3.1 Basic Specifications of the App

Our app operates on a smartphone or tablet running the Android operating system. The login screen is shown in Fig. 1. Users can sign up for an account by registering with a valid e-mail address and providing their real name, a username (viewable by other users), height, weight, and age; these data will be used to calculate calorie expenditure in the walking support function in the future.

Fig. 1. Login and user registration screens.

3.2 Safe/Dangerous Location Reporting Function

The safe/dangerous location reporting function allows users to register safe/dangerous locations found during crime prevention patrols in their city. Users can take photos of locations and judge whether it is safe or dangerous. The UI is shown in Fig. 2. The app includes a GPS function that automatically attaches the longitude and latitude of the location to the content added by the user.

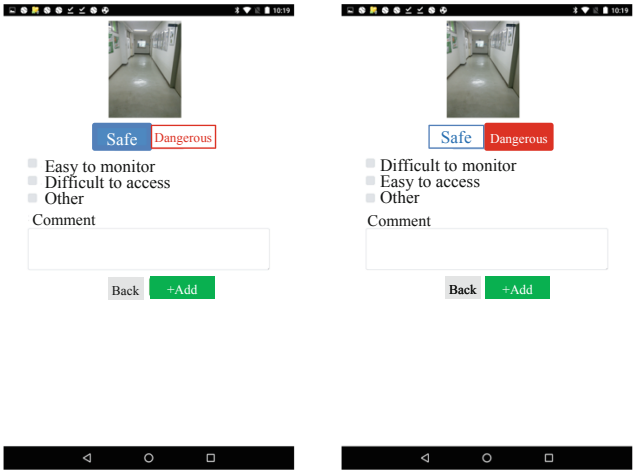

Fig. 2. Safe/dangerous location registration function: tags change (perspectives on safe/dangerous) according to user judgments of "Safe" or "Dangerous."

3.3 Safe/Dangerous Location Sharing Function

Reports registered using the safe/dangerous location reporting function can be viewed using the safe/dangerous location sharing function. Reports registered with longitude and latitude are visualized as a regional safety map. Figure 3 shows the UI of the regional safety map when using the safe/dangerous location sharing function. In this UI, a report is visualized as a flag. Blue and red flags indicate safe and dangerous locations, respectively. Users can browse through the content registered by other users by selecting a flag. In addition to information on judgments and perspectives, users can view the registrant's nickname, their comments, the registration date, the time the report was entered, and a photograph of the location (Figs. 4 and 5).

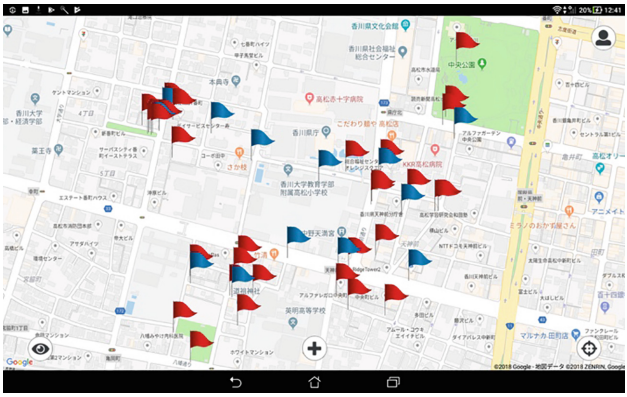

Fig. 3. User interface (UI) of the regional safety map when using the safe/dangerous location sharing function. (Color figure online)

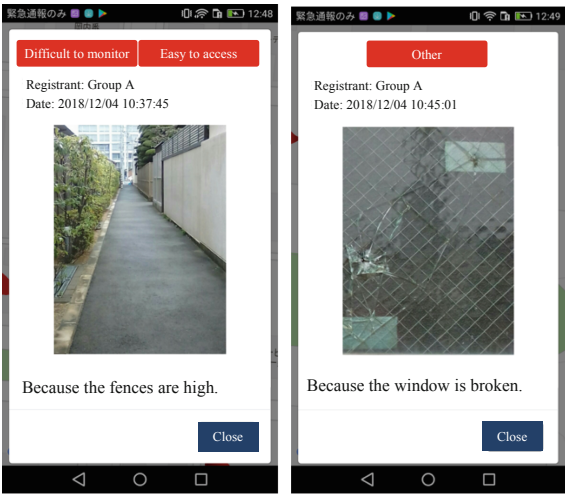

Fig. 4. UI of a report confirmation when using the safe/dangerous location sharing function (shown is an example of a dangerous location report).

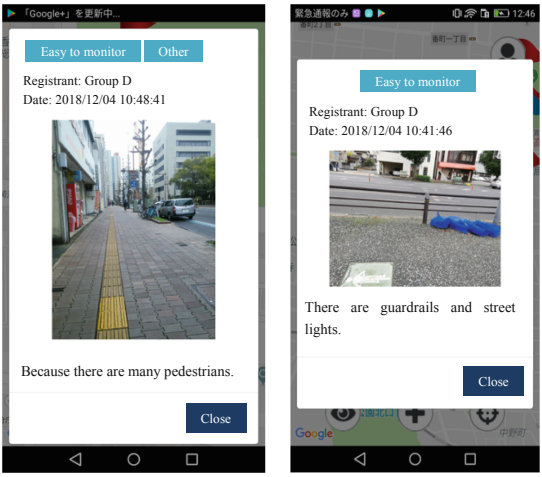

Fig. 5. UI of a report confirmation when using the safety/dangerous location sharing function (shown is an example of a safe location report)

4 Practice

4.1 Purpose

We examined the usefulness of our app based on usage logs and a questionnaire survey. We also considered whether this app could be utilized in lessons at local educational institutions or in events promoting crime prevention. Data obtained from the use field testing were then used in university and elementary school lessons.

4.2 Method

The development of this dual-function app as described in Sect. 3 was completed on June 19, 2018, after which three lessons were conducted at universities and elementary schools. Table 1 shows the contents and conditions of the lessons. In addition to usage logs, a questionnaire survey for which the students were required to provide their name was conducted after lesson B. The question items are shown in Table 2. For Q1–Q3 and Q5, users responded on a four-point Likert scale, from "1. Strongly disagree" and "4. Strongly agree", and Q4 was a free-answer question (Table 4).

Table 1. Contents of the lesson

Date	Lesson	Users	Course content
July 17, 2018	Lesson A: Kagawa University lesson "Theme C" (first year)	Kagawa University students 24 people	• Android users installed the app and registered in the week before the practice day • On the day of the class practice, about a 10-min lecture on perspectives was given. After that, fieldwork was carried out for about 50 min using the app. Finally, the regional safety map was reviewed in the room for about 10 min
November 16, 2018	Lesson B: Kagawa University lesson "Personality psychology" (second year or higher)	Kagawa University students 64 people	
December 3–5, 2018	Lesson C: Kagawa University attached to Takamatsu Elementary School (fourth graders) Class practice by Kagawa University students belonging to the Faculty of Education	Kagawa University attached to Takamatsu Elementary School (fourth graders) About 30 people	• December 3: A 60-min lecture on perspectives • December 4: About 60 min of fieldwork using the app • December 5: A 60-min group presentation by elementary school students using the regional safety map

Table 2. Questionnaire items (in lesson B)

Question item
Q1 Are you usually aware of safe places while walking around the city?
Q2 Are you usually aware of dangerous places while walking around the city?
Q3 Have your views towards the city and your aware about crime prevention changed as a result of using the app?
Q4 Regarding Q3, what specific changes have you experienced?
Q5 Did you enjoy the crime prevention walking activities using this app?

Table 3. Usage logs in lesson A (first-year university students)

Group	Member	Reported number		Selected number of perspectives on safety			Selected number of perspectives on dangers		
		Safe	Dangerous	Easy to monitor	Difficult to access	Others	Difficult to monitor	Easy to access	Others
A	3	6	7	5	1	1	7	3	2
B	3	5	7	5	1	0	5	2	0
C	3	4	10	4	0	0	7	1	0
D	3	1	2	1	0	0	2	2	0
E	3	2	8	2	0	2	8	4	8
F	3	2	4	2	0	0	2	0	1
G	3	0	4	0	0	0	2	0	2
H	3	0	10	0	0	0	9	5	0
	Total	20	52	19	2	3	42	17	13

5 Results and Discussion

Tables 3 through 5 show the numbers of reports and tags given in each lesson. Focusing on the total reported numbers in each table, for all of the demonstration lessons, there were more than double the number of reports of dangerous compared with safe places, which suggests that users tend to pay more attention to dangerous locations.

Focusing on the selection of keywords, the highest number were chosen for "difficult to monitor", followed by "easy to access", "easy to monitor", and "difficult to access". Because these values also depend on structural aspects of the city, we cannot directly discuss any associations with individual cognitive ability; however, we believe that we can clarify the possibility of further improvement based on the data, such as accounting for bias in viewpoints and requesting additional examples of judgements such as "difficult to access" to further clarify their intended meaning.

Table 6 shows the results of the questionnaire survey for demonstration lesson B. The participants stated that they were not particularly aware of safe and dangerous locations while walking through the city. However, after using the app, they reported experiencing a change in awareness of safety and noted that they enjoyed the sense of security provided by the app while walking.

Table 7 shows the views of the city held by the users in lesson B and their changes in awareness of crime prevention based on their free responses, which were categorized and aggregated by category. In total, 54 respondents answered "3. Agree" or "4. Strongly agree". In addition, 50 respondents provided free responses. The authors classified and extracted the changes in awareness among the users after they had used the app. The most common type of description (N = 22/50) involved "Awareness during usual street walking" (e.g., "There are plenty of dangerous places, I just had not noticed", "I thought that I should be careful because I understood that it was dangerous", "I think I became more sensitive to dangerous places."). This suggests that the

Table 4. Usage logs in lesson B (second-year university students and higher)

Group	Member	Reported number		Selected number of perspectives on safety			Selected number of perspectives on dangers		
		Safe	Dangerous	Easy to monitor	Difficult to access	Others	Difficult to monitor	Easy to access	Others
A	4	3	6	3	0	0	6	6	0
B	4	0	4	0	0	0	4	2	0
C	4	0	3	0	0	0	3	0	0
D	4	0	6	0	0	0	3	3	4
E	4	0	3	0	0	0	1	0	2
F	3	1	5	1	1	0	5	4	0
G	4	2	2	2	0	0	2	1	0
H	4	1	8	1	1	1	7	4	1
I	4	0	5	0	0	0	3	5	5
J	5	0	2	0	0	0	1	2	0
K	3	0	6	0	0	0	5	2	0
L	3	0	3	0	0	0	3	0	0
M	3	0	5	0	0	0	3	2	0
N	3	4	5	4	0	0	3	0	0
O	3	1	10	1	0	1	4	4	8
P	3	0	5	0	0	0	3	1	0
	Total	12	78	12	2	2	56	36	20

Table 5. Usage logs in lesson C (fourth-grade elementary students)

Group	Reported number		Selected number of perspectives on safety			Selected number of perspectives on dangers		
	Safe	Dangerous	Easy to monitor	Difficult to access	Others	Difficult to monitor	Easy to access	Others
1	1	5	1	0	1	3	4	3
2	3	5	1	0	0	4	4	0
3	0	3	0	0	0	2	0	1
4	3	4	3	0	1	4	1	3
5	0	5	0	0	0	4	5	0
6	2	3	2	2	0	2	2	1
7	1	4	1	0	0	3	0	0
8	3	3	2	0	0	2	3	0
9	2	3	2	0	0	2	1	0
Total	15	35	12	2	2	26	20	8

Table 6. Questionnaire results from lesson B (four-point Likert scale, H_0: $\mu = 2.5$, H_1: $\mu \neq 2.5$)

Question item	Average	SD	t	p
Q1	2.03	0.77	−4.60	0.000**
Q2	2.28	0.79	−2.16	0.035*
Q3	3.36	0.61	10.72	0.000**
Q5	3.16	0.50	10.10	0.000**

* significance level of 5%
** significance level of 1%

app motivated the users to be more aware during usual city walking. The next most common type of description (N = 16/50) involved "Reflection/improvement of behavior" (e.g., "I was taking a dark and narrow road to go to the convenience store around midnight, but then I thought it would be better to walk along a well-lit street instead", "I noticed that some of the places I usually walk through are dangerous."). The third most common type (N = 10/50) of description involved a "Quantitative grasp of safe/dangerous locations" (e.g., "I learned that there are many dangerous places in the neighborhood", "It seems that there are fewer safe places"). The safe/dangerous location sharing function of the app allows users to view the content that was shared in each group in real time on the map, allowing them to quantitatively grasp the safe/dangerous locations in the city; this suggests that the app could potentially increase interest in the entire region.

Table 7. Change in awareness of app users in lesson B

Category	N
Awareness of usual walking behavior	22
Reflection and improvement of behavior	16
Quantitative grasp of safety/danger points	10
Use of keywords for dangerous spots	8
Perception of importance of scenery assessment ability	1

Furthermore, the importance of the "Use of keywords for dangerous spots" and the "Perception of the importance of location assessment ability" were recognized. The purpose of this app is to train attitudes in terms of gaining an understanding of an area by making judgements about safety. The data obtained in this suggest that the app has the potential to fulfill this purpose.

6 Conclusion

In this research, we developed a walking app for crime prevention, "Aruite Mi Mai", with a safe/dangerous location reporting function as a method to implement safe and secure city development. The results of field testing suggest that users of the app support other users based on usage trends and that this app is useful for learning about crime prevention perspectives. However, we could not evaluate the extent to which the app is useful in terms of learning perspectives. Therefore, in a future study, we will study feedback methods based on accumulated usage logs and consider practical models that can evaluate user performance in multiple ways.

This research established an environment for risk sharing in relation to safe and secure city development. Therefore, to develop a function for summarizing reports, as in the study by Hayakawa et al. [7], and for grouping users, as in the study by Nakamura et al. [8], Hirunuma et al. [9], we plan to add new functions to the app to enhance awareness of group activities, such as the abilities to organize crime prevention events and to record and share results on a per event basis by any user. We expect these functions to promote the growth of community crime prevention. We also plan to improve the usefulness of this app by analyzing its growth, and the factors that contribute to its growth, and by monitoring long-term changes in individual performance.

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