Proposal for a System of Mutual Support Among Passengers Trapped Inside a Train

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Abstract. The Japanese railway system has the greatest accuracy and safety in the world, with a low frequency of delays and a small number of accidents. However, even in such a railway system, a train must sometimes make an urgent stop in emergencies, as a result of an earthquake or other accidents. Most railroad companies have a safety measure in which a train must make an urgent stop in order to confirm safety during emergencies. In the worst cases, passengers have been trapped in a train for a period greater than 24 h. In such a situation, some passengers, such as the elderly or pregnant women, may suddenly become ill, as a result of chronic illnesses, poor conditions, or stress due to the tense situation. In case of emergencies, the limited number of crewmembers on a train are not able to deal with passengers efficiently. Therefore, we suggest an extempore community formation system for passengers who are trapped inside a train in order to promote mutual support during an emergency. Results of an evaluation experiment reveal the usability of the proposed system.

Keywords: Support system · Community formation · Mutual support · Trapped passengers · Train

1 Introduction

Japan has a highly advanced railway system, which services both urban and rural areas. Hence, many people use trains for their commute and the Japanese railway system is deemed as one of the most important modes of transportation. However, Japan is also a nation prone to earthquakes or suicide, a train is required to make an emergency stop. Consequently, passengers may become trapped inside a train during emergencies. Japan is a nation prone to earthquakes and experiences more earthquakes compared to other countries. When an earthquake occurs, a railroad company must urgently stop a train to ensure safety. Meanwhile, approximately 600 accidents are recorded annually, with at least one suicide attempt on the railroad occurring per day. During such situations, affected trains are urgently stopped. The effect of this urgent stop spreads to other trains, and passengers in these trains may be trapped inside and have to wait until the situation is resolved. The length of time they may be trapped depends on the cause

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of the emergency situation of the train. If a train stops at a place in between stations, the passengers may be trapped inside for a long period of time.

In such a trapped scenario, there is a likelihood that problems may arise in passengers, owing to an increase in stress, worsening of a chronic disease, or emergence of poor health. Generally, in such situations, the crew in the train deal with emergencies. However, in a trapped situation, it is possible that more than one emergency will occur at a time. Typically, the crew consists of only one or two people, and this limited number may not be able to attend to all the emergencies that may occur. Therefore, a mutual support system among passengers is important to aid in the response to emergencies.

This research formed a community plan to perform mutual support among passengers in the case of an emergency stop. In using this system, when a user is trapped with person they do not know, anxiety and impatience can be softened by sharing information. In addition, It's possible that the users go to passengers location that is problem occurred in case of emergency. Furthermore, this system is improved and the problem is simulated via an evaluation experiment.

2 Related Works

2.1 A Disaster Management Platform Based on a Social Network System Oriented to the Self-Relief of Communities

Dominguez-Rios *et al*. conducted a study on a disaster management platform based on a social network system (SNS) to promote mutual support in communities [1]. This system performed multilingualization using a universal design approach. Moreover, the system was devised such that the interface was user-friendly. The system classified users into the following four groups in order to enable smooth mutual support:

1. Medical Group: These are users with medical skills that may be useful to perform a task and assist other users in need.
2. Search and Rescue Group: These are users who officially belong to a search and rescue agency. If the helper is near the location of the person needing help, these individuals can assist others directly and inform others about rescue efforts in a specific area.
3. Communication Group: These are users who are witnesses to an event and can communicate about the event with other users in the system. These users should have important skills such as knowing a foreign language or skills with appropriate media in order to access important information that may be useful.
4. Evacuation Group: Agencies such as fire departments, public health agencies, and public utilities impart preventive efforts. Using the reports generated by this system with the aid of feedback from the community, public agencies can perform their tasks.

This research reveals the usefulness of the formation of a community based on an SNS. The use of SNSs has increased over recent years. It is very effective in the formation of a community, as the attributes of a user and their social aspects are included. This research confirms the importance of mutual support by a community. However, there is currently a lack of research into community formation in limited space.

2.2 The Necessity of Mutual Support During an Emergency

Mutual support is cooperation between members of a family, company, or local community [2]. The necessity of mutual support during an emergency has been made evident in previous studies [3]. For example, an individual will have to share information and perform self-help and mutual support when a large earthquake occurs, as administrative relief and rescue efforts may be late in arriving. In such a scenario, the only way to protect oneself is to cooperate with people nearby. During the 1995 Hanshin Awaji earthquake disaster, approximately 80 % of survivors in need of rescue were assisted by their families and/or neighbors [4].

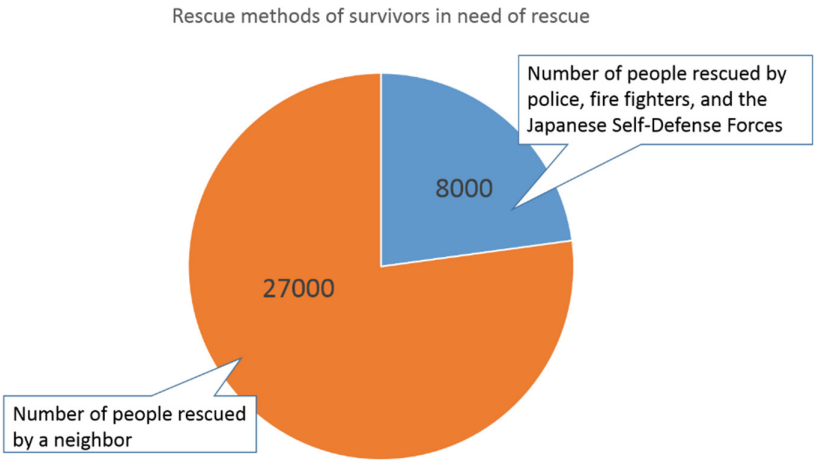

Fig. 1. Number of people rescued in the 1995 Hanshin Awaji earthquake according to the type of savior.

Figure 1 shows the importance of mutual support in emergency situations. Furthermore, self-help is a basis of protection against disasters and is a very important factor during an emergency. Community is not only people's lives more prosperous. It is vital that people cooperate when faced with an emergency. Daily activities performed by a community revitalize that community. Daily activities by a community will form a basis to protect the lives of the people during a disaster.

3 System Proposal

3.1 System Summary

In this research, we propose a system that provides mutual support through the formation of an instant community via vehicles. No such system has been previously proposed. Therefore, it is necessary to consider a system that everyone can use effectively when passengers are trapped inside a train (which is a scenario that can occur any time). Therefore, the following three criteria should be satisfied by this system:

1. It should be possible to form a community immediately during an emergency situation;
2. The position of a train with trapped passengers in trouble can be specified; and
3. The system is easy to use even during an emergency situation.

The solutions for these three criteria are described below:

1. It is necessary to form an original community. The Twitter [5] and Facebook [6] SNSs exist, but it is difficult to use these to detect a problem on a specific vehicle. Therefore, this system forms a community by accessing a designated URL on the train that experiences trouble. Consequently, passengers are able to access this system and connect mutually.
2. In this system, there are a number of images representing individual vehicles. When a patient experiences an emergency, the image changes to an image that indicates an emergency. In addition, even if the passengers in the emergency situation cannot use the system themselves, it is possible that a nearby user can report the situation.
3. This problem is resolved by using pictograms in the system. It is believed that a system with a simple design is easier for users. Even if a single user is in an urgent situation, he or she can transmit information by tapping his or her smartphone several times.

This research does not focus on specifying the position of a user in a train and the communication environment. Because this research is inspection of system's effectiveness. Thus, the system uses an external system for these functions.

3.2 Development Environment

This system is a web application that is built using HTML, PHP, and JavaScript. Data acquisition from a database and input of data to a database are implemented using a PHP script.

It is assumed that most passengers have access to a smartphone. Hence, this system makes a community that shares information via smartphones. In order to use the system and respond to an emergency situation, it is assumed that a user knows the system URL.

3.3 System Operation

This system allows a rescue to be performed even if the user is on a vehicle of anywhere. The system is arranged as follows:

- Main Screen:
  The initial screen is the main screen of the system, and all procedures are mainly conducted from this screen. The system has a simple design and therefore can be used during an emergency situation. A user can grasp the situation of the train through the change of the vehicle image (see Fig. 2).

- Rescue Request Button:
  This button is to be used when the degree of urgency is high (*i.e.*, an emergency situation). This action then changes the vehicle image into an image that informs of an emergency.
- Bulletin Board:
  Users can access this bulletin board from a vehicle image when an emergency occurs. The user may contribute detailed date and ID information, severity of an illness, and vehicle location (Fig. 3).

Fig. 2. Image change

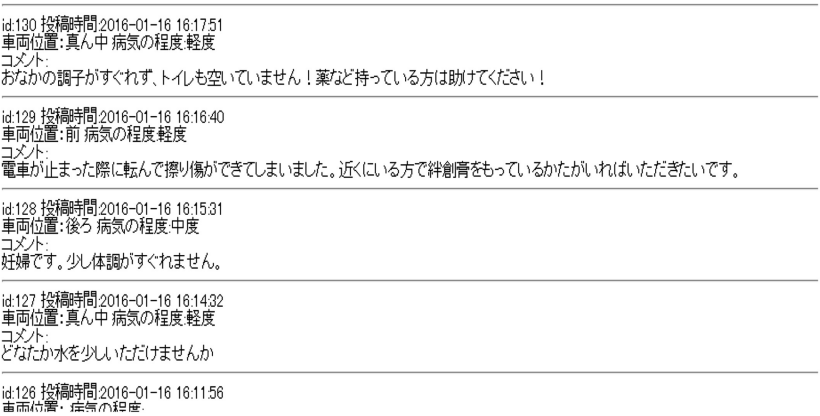

Fig. 3. Bulletin board

3.4 System Flow

This section describes the system flow (Fig. 4), as follows:

1. The user starts the application.
2. When a problem occurs, the user taps the HELP button on the main screen. The vehicle image in the system then changes to another vehicle image that informs of the occurrence of a problem. This system assigned value to vehicle image. This is retained by the system as a value representing the vehicle image. This value is stored in an “image” table in the database.
3. When users contribute to a bulletin board, information on the vehicle location, severity of the illness, and other relevant data are used as inputs. This data is then stored in a “member” table in the database.

4. The contribution to the bulletin board is stored in a "posts" table in the database.
5. At the same time, the contribution time and ID are assigned and inserted in the "posts" table.

An example of the system flow is shown in Fig. 5.

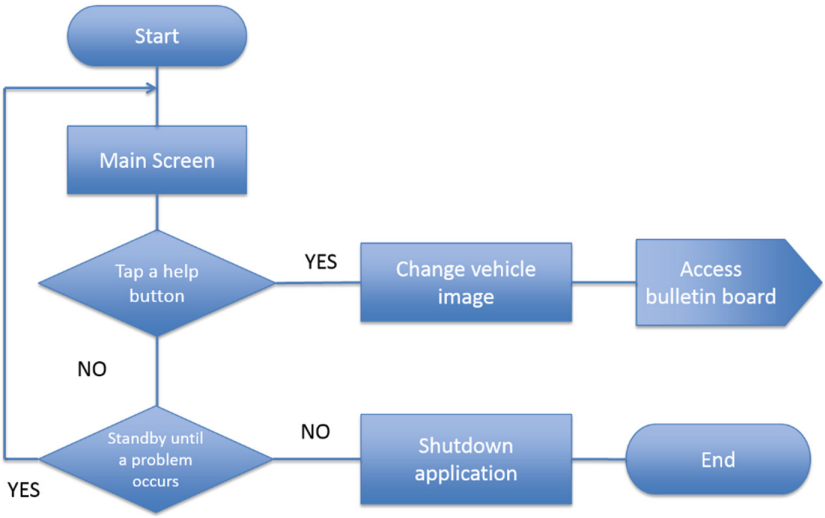

Fig. 4. System flowchart

4 System Evaluation

4.1 Experiment Flow

The experimental procedure is as follows:

1. The URL of the system is conveyed and a role is assigned in advance.
2. The subjects board an appointed vehicle, after which the experiment commences.
3. Subjects in the role of dealing with the medical crisis use the system and are informed of the problem.
4. The other users go to the rescue using the system.
5. The experiment concludes upon the arrival of a user at the scenario of the medical crisis.

4.2 Attributes of the Subject

A role (two emergency patients, two passengers, one doctor, one nurse) and a vehicle were assigned by an experimenter to each subject at random, after which the experiment commenced. The subjects were named A–F and the results are summarized in Table 1.

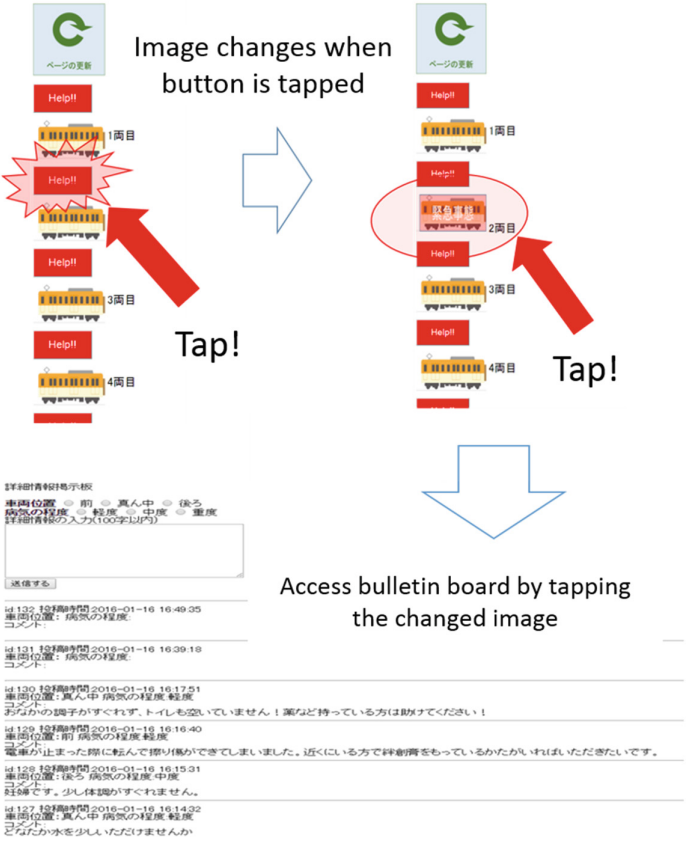

Fig. 5. An example of system operation on the main screen

Table 1. The attributes of the experimental participant and the roles

Subject ID	Age	Gender	Role (going)	Role (returning)
A	21	Man	Passenger	An urgent case (A fit)
B	22	Man	Passenger	Doctor
C	22	Man	Nurse	An urgent case (Giddiness and nausea)
D	21	Woman	Doctor	Passenger
E	21	Woman	An urgent case (Giddiness and nausea)	Nurse
F	22	Woman	An urgent case (A fit)	Passenger

4.3 Experimental Results

To confirm the usefulness and specification of the system and the validity, I conducted questionnaire.

The questionnaire and its results are presented in Table 2.

Table 2. The results of the experimental questionnaire.

Question	A	B	C	D	E	F
① How many times do you take a train every month?	Almost every day	2 or 3 times a week	Do not take it so much	1 or 2 times a week	1 or 2 times a week	1 or 2 times a week
② Have you experienced being "trapped inside a train" for more than 1 h?	No	No	No	No	No	No
③ Did you think this system is simple?	3	3	3	3	3	3
④ Were you able to easily operate this system?	1	2	4	4	4	4
⑤ Can you quickly specified a vehicle as occurring a problem?	2	2	3	3	3	3
⑥ We assume that you are a medical practitioner. Can you hurry in a vehicle to the place of the medical crisis using this system?	2	3	2	2	3	3
⑦ Can you perform mutual support by using this system?	3	3	3	4	4	4

4: Strongly agree 3: Agree 2: Disagree 1: Strongly disagree

As there were only a few test subjects, there was no one who had experienced the situation of being trapped inside a train. Therefore, it appears that they have no techniques for dealing with this problem. Furthermore, all the subjects stated that suggestions can be viewed easily in the main screen. As a result, a user was able to quickly distinguish the location of a person who had experienced a problem (4/6 persons). However, two people stated that the system was difficult to operate. I think, it is the rescue request button was located near to the vehicle image, and incorrect operations resulted. Other opinions in conjunction with the user interface were provided. These provided a good evaluation of the usefulness of mutual support using this system. Hence, the results of the questionnaire indicated the effectiveness of this research.

5 Conclusion

This paper proposed a system for the formation of a mutual support community for passengers in the event of passengers being trapped inside a train. The problem was formulated under the assumption that a limited number of crewmembers cannot deal with many passengers efficiently. The importance of mutual aid between passengers was confirmed from a mutual assistance point of view. It is believed that this study is necessary for the future of the Japanese society, which can be referred to as a railroad society.

In the future, meetings will be held with railroad companies and evaluation experiments will be performed with individuals who have experienced the situation of being trapped inside a train. Furthermore, the user interface of the system will be improved.

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