

A Survey on the Sense of Fire Safety and Evacuation Guide System

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ABSTRACT

This is a basic study of the materials that induce the excavation alarm sound that was compiled based on a survey regarding the evacuator's general recognition of fire and preferred alarm sounds. Based on the study results, people's recognition of fire safety at the familiar areas has increased, but not at a new place. Therefore, proper education and a system for fire safety recognition in new places seem to be required. In the results of studying the expected bearable length of time in a fire and the length of time to evacuate safely, they are recognized to be very short, so proper initial actions are required. When the visibility is disrupted, people most preferred an alarm with a woman's saying 'the exit is this way.' with sirens and lights that lead the evacuation..

1. INTRODUCTION

1.1 BACKGROUND AND OBJECTIVE

According to the 2009 fire statistics from the National Emergency Management agency, the number of fire accidents that occurred in Korea was 47,318 cases, 2,441 people were injured, and there were 251.8 billion won in personal and financial damages. Many plans have emerged to decrease personal and financial damages from fire. One of them is to use evacuation guidance system to guide people to a safe place during a fire to decrease the personal injuries.

Current evacuation guidance fire systems consist of guidance lamps, guidance signs, evacuation guidance alarms, and portable emergency lamps, etc. The evacuation guidance lamp is a light-oriented guidance system and the guidance sign is an image-oriented guidance system. Moreover, the evacuation guidance alarms, used to assist the visual evacuation systems in basement spaces, direct people to go in the correct directions and to the correct locations when a disaster occurs, have been recently planned and installed. In case the visibility is too low, due to smoke from a fire, existing lamps and signs can't play their roles properly. Therefore, in order to apply an evacuation guidance alarm system which has not regulated, the basic alarm features are studied to find effective alarm sound.

The main purpose of the evacuation alarm system is to provide clear guidance information so people can recognize the correct evacuation directions and locations. In order to do that, specific expression methods of the voice information provided from the evacuation guidance alarm system are reviewed then, the tempo and musical features are changed to study how well the information could be recognized with the background sound. Moreover, in order to deliver the direction information of the safe exit to evacuees, the sense of direc-

tion of the evacuation guidance alarms that use the Hass Effect are compared through experiments to develop the optimized evacuation guidance alarm system for safe evacuation. Figure 1 shows the overall study flow on the evacuation guidance system.

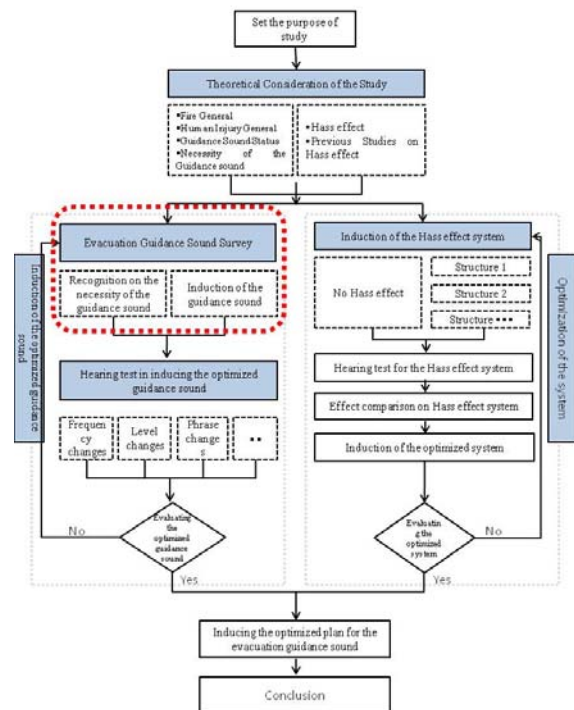


Figure 1. Study Flow on the Optimized evacuation Guidance System

In this study, the survey is conducted regarding the evacuation guidance alarm sounds in order to research about people's recognition of fire safety and evacuation guidance system as well as the necessity of the guidance system. By inducing the evacuation guidance alarm sound through the safety recognition, it is to induce the optimized the evacuation guidance alarm sound through the hearing experiment in the future. In order to induce the evacuation guidance alarm sound that can accurately deliver information quickly in an indoor space, recognition of fire safety and evacuation guidance alarm systems was researched. This will be used as the basic material to induce the evacuation guidance alarm sound.

2. STUDY SUBJECTS AND METHODOLOGIES

The survey paper was distributed to teens, college students, adults, and fire station officers who actually work at the fire field. The survey paper was distributed after requesting their cooperation, then the objective of study and the contents of the survey prior to conducting the survey were explained to them.

The survey contents used in the study consist of the major concept of the research and the preference for the voice guidance sound, and it was compiled through literature-based research and advice from fire experts. Except for 44 papers that had unclear answers, out of a total of 340 distributions, a total of 296 survey papers were used for statistics by using the SPSS 15 program.

The survey contents are as follows. The first questionnaire was about the respondent's socio-demographic and housing characteristics such as gender, year of birth, job, number of floors in their house, and housing type. The second questionnaire was for when the respondent was in the house, and it was about general fire-related things such as fire experiences, experience of installing an extinguisher, knowledge on using a fire extinguisher, experience with using a fire extinguisher, knowledge on the evacuation route, expected bearable time, and expected time to safely evacuate. The third and fourth questionnaires were about when the respondents were at work or at other places, and the same questions from the second one were asked. The sixth questionnaire was about the factors that they think would be the most difficult obstacles. The seventh question was about the effectiveness of the evacuation guidance system during a fire. Finally, they were asked whether or not the evacuation guidance sound would be helpful, what the proper guidance phrase is, human voice, and controlled evacuation guidance sound.

3. FIRE RECOGNITION ANALYSIS ON SURVEY MATERIAL

3.1 DEMOGRAPHIC & HOUSING FEATURES OF SURVEY TARGETS

The demographic and housing features of the survey targets are outlined in Table 1. Approximately 59% of the respondents were male. And for age, under the age of 20 was the dominant as 41.9%, then age 20~29 was 28.7%. The dominant job was student (71.14%), then fire-fighters and other related field government officials were 9.4% and 2.01% each.

For the housing features of the survey target, the stair type in a complex was more than half (51.7%). Next was hallway

type and single house type (23.6% and 21.3%). For the number of stories, between 6~15 were the dominant at 42.2%.

Table 1. Outline of the socio-demographic and housing features

Category	Division	f	%
Gender	Male	175	59.1
	Female	121	40.9
Age	Under 20	124	41.9
	20 ~ 29	85	28.7
	30 ~ 39	53	17.9
	40 ~ 49	30	10.1
	Over 50	4	1.35
Job	Student	212	71.14
	Company employed	8	2.68
	Housewife	34	11.4
	Official	6	2.01
	Fire fighter	28	9.4
	Educator	3	1.01
	Medical staff	1	0.34
	Others	4	1.34
Housing Type	Hallway type	70	23.6
	Stair type	153	51.7
	Commercial & residential complex	10	3.4
	Single house	63	21.3
Number of stories	Under 2 stories	86	29.1
	3 ~ 5 stories	50	16.9
	6 ~ 15 stories	125	42.2
	16 ~ 20 stories	31	10.5
	Over 21 stories	4	1.4

3.2 FIRE EXPERIENCE AND RECOGNITION OF SURVEY TARGETS

It is known that the initial response when fire occurred highly affects the safe evacuation. The initial response to fire would change the success of evacuation based on their general knowledge of fire, whether or not they have acquired information on fire evacuation, and their personal character when responding to a dangerous situation.

In order to induce the necessary factors in predicting evacuator's responses of evacuees or planning the evacuation, their fire experiences, recognition on evacuation and their characters are studied. Table 2 shows their general fire-related experiences and recognition level in the categories of house, work, and new places. Since most of the survey respondents didn't have fire experiences at home(87.5%), work(87.5%), and a new place(92.6%), it was considered that they can be effective for the evaluations on other items.

Extinguishers are installed at home (61.8%) and at work (86.5%) and 83.6% people knew how to use the extinguisher at home and 81.4% knew how to use the extinguisher at work. Through the recognition survey on extinguishers, it is considered that people's recognition on initial suppression has increased.

Although the recognition on how to use an extinguisher was high, many people didn't experience fire, so the actual experience of using the extinguisher was only 36.5% at home and 32.5% at work. The respondents who said they know the evacuation path was 78.0%(home) and 67.9%(work) and the people who said they know how to use the evacuation tools are 68.2%(home), and 66.6%(work). Likewise, although many people knew about the necessary information for initial fire response, such as guidance on evacuation path, how to use evacuation tools, and how to use extinguishers, since many people have a lack of actual experience in using these things, more practice or experience are required in the system.

Moreover, the survey respondents seemed to have lower recognition on fire at a new place rather than a familiar place. 62.2% of people don't check whether or not there are extinguishers in a new place, and only 52.4% tried to find out how to use an extinguisher. Only 50.3% of people find out the evacuation path and only 69.6% find out how to use the evacuation tools. Therefore, a systematical education and campaigns are required so people can acquire the necessary information for the initial response during a fire in a new place.

Table 2. Fire related experiences and knowledge characteristics

Category	Division	f	%
House	Fire experience	Yes	37 12.5
		No	259 87.5
	Extinguisher installation	Installed	183 61.8
		Not installed	113 38.2
	How to use extinguisher	I know	247 83.4
		I don't know	49 16.6
	Extinguisher using experience	I have	108 36.5
		I don't have	188 63.5
	evacuation path	I know.	231 78.0
		I don't know.	65 22.0
	How to use evacuation tools	I know.	94 31.8
		I don't know	202 68.2
Work	Fire experience	Yes	37 12.5
		No	259 87.5
	Extinguisher installation	Installed	256 86.5
		Not installed	40 13.5
	How to use extinguisher	I know	241 81.4
		I don't know	55 18.6
	Extinguisher using experience	I have	97 32.8
		I don't have	199 67.2

evacuation path	I know	201	67.9
	I don't know	95	32.1
How to use evacuation tools	I know	99	33.4
	I don't know	197	66.6
Fire experience	Yes	22	7.4
	No	274	92.6
Extinguisher installation	I check	112	37.8
	I don't check	184	62.2
Finding how to use extinguisher	I check	141	47.6
	I don't check	155	52.4
New place Extinguisher using experience	Yes	66	22.3
	No	230	77.7
Finding the evacuation path	I check	147	49.7
	I don't check	149	50.3
Finding how to use evacuation tools	I check	90	30.4
	I don't check	206	69.6

3.3 EXPECTED BEARABLE TIME IN A FIRE

The bearable time when a fire occurs generally varies depending on the heat discharge amount, air temperature, and the amount of poisonous gas. In order to find out how seriously the survey respondents consider the importance of the initial response and quick evacuation, the "bearable time during the fire and excavating time" were researched and the results are provided in Table 3.

For the expected bearable time during a fire at home, 41.2% answered less than 3 minutes, and 42.9% less than 10 minutes also regarding the safely evacuation time, 26.7% answered less than 3 minutes and 38.5%, less than 5 minutes. Moreover, the expected bearable time at work for less than 3 minutes was 40.2%, and 41.2% answered less than 10 minutes, and for the safe evacuation time, 27% answered less than 3 minutes, and 36.5%, less than 5 minutes.

Likewise, the expected bearable time and safe evacuation time was recognized to be 5-10 minutes, and this is similar to the survey result, conducted in America, saying that the safe evacuation time when a fire occurs at home would be 6 minutes until life can get threatened. However, since the evacuation time has to be shorter, more education seems to be required.

Table 3. Expected Bearable Time and evacuation Time in Fire

Category	Division	f	%
Home	Expected bearable time	Less than 1 min	25 8.4
		Less than 3min	122 41.2
		Less than10 min	127 42.9
		Less than20 min	13 4.4
		More than30 min	9 3.0

Safe evacuation time	Less than 1 min	51	17.2
	Less than 3min	79	26.7
	Less than 5 min	114	38.5
	Less than 10 min	47	15.9
	Less than 20 min	3	1.0
	More than 30 min	2	0.7
Expected bearable time	Less than 1 min	28	9.5
	Less than 3min	119	40.2
	Less than 10 min	122	41.2
	Less than 20 min	16	5.4
	More than 30 min	11	3.7
Work	Less than 1 min	51	17.2
	Less than 3min	80	27.0
Safe evacuation time	Less than 5 min	108	36.5
	Less than 10 min	50	16.9
	Less than 20 min	5	1.7
	More than 30 min	2	0.7

4. SURVEY MATERIAL ANALYSIS ON EVACUATION GUIDANCE SYSTEM

4.1 OBSTACLE FACTORS DURING EVACUATION

When an indoor fire occurs, many obstacle factors can occur during a safe evacuation. If proper responses are not prepared against such obstacles, much bodily injury can occur during a fire. Therefore, the factors that can be obstacles to evacuees during the fire were researched. The survey results are in table 5. Specifically, regarding the obstacle factors during a fire, 55.7% of survey respondents choose breathing disorders, 25.3% chose visual obstacles, 10.5% chose loss of a sense of direction, 5.4% chose structures, and 3.0% chose others.

Through the survey results, it was found that most people consider smoke inhalation as the most dangerous factor. Also visibility obstacle and the loss of a sense of direction were also considered to be dangerous factors.

Table4. Obstacles for evacuation during the fire

Division	f	%
Breathing Disorder	165	55.7
visibility obstacle	75	25.3
Loss of sense of direction	31	10.5
Structures	16	5.4
Others	9	3.0






4.2 PERFORMANCE OF THE EVACUATION GUIDANCE SYSTEM

current evacuation guidance systems use guidance lamps and guidance signs. These indicate the locations of exits and directions for easier evacuation during a fire, and also provide effective lighting above openings and hallway walls or floors to guide the evacuation. Moreover, in case it is difficult to identify the guidance lights due to smoke in the previous evacuation system, a system to turn off the lamps from the fire sign or guiding the exit direction with a voice is also used.

In order to determine the performance of such evacuation guidance systems when the visibility is blocked, a survey was performed and the results are provided in table 5.

In the survey results, an overall majority answered that the evacuation guidance system is pretty effective. Especially 67.3% answered that the evacuation guidance sound will be effective, which they evaluated the possibility of the performance more than the system that used lighting.

Table5. Effectiveness of the Evacuation Guidance System

Division	Not helpful at all		Not helpful		Average Effective		Very effective			
	f	%	f	%	f	%	f	%		
Path guidance lamp	9	3.0	31	10.5	144	48.6	90	30.4	22	7.4
										
Exit guidance lamp	9	3.0	31	10.5	110	37.2	113	38.2	33	11.1
										
Evacuation guidance line	7	2.4	24	8.1	85	28.7	123	41.6	57	19.3
										
Evacuation guidance sound (guidance broadcasting)	3	1.0	18	6.1	73	24.7	115	38.9	84	28.4
										
Emergency lamp	11	3.7	53	17.9	100	33.8	84	28.4	48	16.2
										

4.3 SURVEY ANALYSIS ON EVACUATION GUIDANCE

In case the visibility is totally blocked due to smoke, whether or not using the voice to direct the evacuation was used to adopt an evacuation guidance system as well as the preference of the voice type.

First of all, 73% of the survey respondents answered that the voice evacuation guidance system would be helpful to evacuate during a fire. Although about 20% said they don't know, it is because not many evacuation guidance systems that use a voice have been adopted in Korea, therefore those answers are considered to be the result of a lack of experience.

Also for the phrases that is preferred to be used in the voice evacuation guidance system. 'The exit is this way' got the most responses, at 46.6%.

78% said that a woman's voice sounds more clear. However, female respondents tended to choose a male's calm voice. For the effectiveness of the complex evacuation guidance method, "siren+human's voice+light" were selected the most, at 36.1%. It is considered that people were expecting the highest evacuation guidance effect by combining every guidance method.

Table 6. Survey on Evacuation Guidance Sound

Category	Division	f	%
Evacuation guidance sound	Helpful	216	73.0
	Not helpful	21	7.1
	I don't know	59	19.9
Guidance sign	Here is the exit.	51	17.2
	The exit is this way.	138	46.6
	It is the exit.	13	4.4
	The exit is here. .	38	12.8
	Exit, Exit	43	14.5
	Others	13	4.4
Human's voice	Female	231	78.0
	Male	65	22.0
Evacuation guidance sound methodology	Bell (Chime bell sound)	7	2.4
	Siren	31	10.5
	Human voice	14	4.7
	Bell+Human voice	31	10.5
	Siren+Human voice	42	14.2
	Bell+Human voice+Light	57	19.3
	Siren+Human voice+Light	107	36.1
	Others	7	2.4

5. CONCLUSION

This study is the basic material to induce the evacuation guidance sound and is compiled based on a survey regarding the evacuator's general recognition and preferred evacuation guidance sounds.

From the study results, respondents' fire safety recognition was higher at familiar places such as home and work, but was still low in unfamiliar places. Therefore education and a system for fire safety recognition in unfamiliar places is required.

In the results of researching the safe evacuation time and expected bearable time during a fire, it was recognized to be very short, so the proper initial response is required.

When there is low visibility, the evacuation guidance system that uses a woman's voice saying "The exit is this way" in addition to sirens and lights is most preferred.

Regarding the various evacuation guidance systems including the phrases selected later, this study is to experiment with hearing and actual field tests with various evacuation guidance systems to develop an optimized evacuation guidance system.

EPILOGUE

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