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A Mobile App. UI/UX Design for the Gas Safety Workers

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Abstract

Objectives: There is always the possibility of accidents at gas work site. Therefore, we studied mobile app design for safety of gas workers. **Methods/Statistical Analysis:** In this paper, we used literature investigation and analysis, expert interview, social indirect data collection. 1. Analyze the characteristics of gas field operations, workers, work site and extract need analysis of them 2. Investigate working process and incidents that can take place at the field operations 3. List the assumptions to design the mobile App. 4. Survey on preferred images in relation to gas work 5. Finalize the App. design. **Findings:** These are the demands for mobile App. 1. A clear arrangement of contents, 2. A design with high readability, 3. A design with low death, 4. A securing of user's accessibility, 5. An effective information transmission plan in the work section where it is impossible to operate the mobile device, 6. An activation of alarm function at the section of high working error, 7. A fast two-way transmission and receipt of safety inspection matter needed at work, 8. A selection of images and contents that can guide the situation to the worker in case of accident, 9. An alarm function for the degree of danger in an area of worker's location. Based on these, a basic design of safety application for gas related work has been proposed, that can secure the user accessibility. And we design the new display what is focused on icons of high readability in order to move the main system to the mobile screen. **Improvements/Applications:** 1. Sections where frequent operational errors occur must be identified. 2. It is necessary to explore various interactive devices that can sync with the mobile App.

Keywords: Gas Safety Worker, Gas Work Image Preference, Icon Design, Mobile App., UI/ UX

1. Introduction

Fuel gases are the mainly important energy resources, but also seriously dangerous matter, so involved with a lot of accidents in gas working process and gas work site. This paper aims to figure out the App. design for the gas workers in gas work operations. For reducing the risk of gas work and workers, it is needed to develop an App. to inform workers what occurs during operations and working environment and to alert workers when dangerous accidents happen.

The issue about the safety management of gas related work has been researched toward a direction to utilize IoT system recently. For this purpose, the matters of user's demand have been deduced through the literature survey, field survey, and professional consultation, by researching the characteristics of worker, work, and work site.

The characteristics of the gas workers are as follows.

Holland classifies gas workers as "realistic"[1] and he studies high-level workers have a preference to do manual works such as fixing, repairing and assembling. And they don't enjoy getting noticed, rather they interact with others.

Most of gas workers are exposed and working in a work site of unpleasant odor, light, disproportionate temperature, noise, high humidity and toxic materials. So they have a tendency to be under high stress than general workers[2,3].

Based on the above, we extract needs analyses of gas safety field workers as follows: A clear arrangement of

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contents, a design with high readability, a design with low depth, a securing of user's accessibility.

KSG (Korean Gas Safety Corporation) categorizes accidents related to gas as 6 kinds. Those are Gas Leakage, Suffocation, Explosion, Addiction, Conflagration, Rupture[4]. And we re-categorize those to Conflagration, Explosion (Rupture) and Gas Leakage (which may be related to addiction and suffocation).

And common accidents like 'slipping' and 'falling'[5] happens in gas work site. Huge industrial facilities mostly have 'danger zone'[6], there are accident risks resulting from the inattentions of the workers mostly always[7].

Need Analyses of the Gas field operation are an effective information transmission plan in the work section where it is impossible to operate the mobile device, an activation of alarm function at the section of high working error, a fast two-way transmission and receipt of safety inspection matter needed at work.

Need Analyses of the Gas operation field are the selection of images and contents that can guide the situation to the worker in case of accident, an alarm function for the degree of danger in an area of worker's location. Based on these, a basic design of safety application for gas related work has been proposed, that can secure the user accessibility.

2. Example of App. Use - Focused on the Pipe Work

As inferred from the requirements, the most important factors when designing a gas safety App. are readability and low depth. To implement these, important things is to create initial settings to increase user compatibility, allow the user to skip this stage in subsequent uses and immediately start searching the necessary information. Different operators have different main tasks and thus require such settings. As many applications allow a user to access customized or preselected menu with one single login, the Gas Safety Mobile App. is designed to help a user preset his or her frequently used tasks or frequently looked-up information; in subsequent uses, they can access the selected tasks immediately. For this purpose, the App. allows the operator to choose his or her regular tasks in the initial settings. The prearranged tasks are activated immediately.

Once the App. is activated for the different tasks through such a procedure, it presents procedures and precautions for the selected tasks. The App. divides tasks into one-hand task sections and two-hand task sections. Users can operate the mobile device while conducting their task in case of one-hand tasks, while this is impossible for the two-hand tasks. In two-hand task sections, the App. provides a regular screen that alerts the user on the risks involved with the task, the hazards in the work area, current weather and precautions for the task, and an emergency screen that alerts the cause of accident, escape route, and emergency phone numbers in the event of emergency.

Figure 1 shows an example of the App. utilization during pipe work consists of a total of ten tasks. The stages 1 to 4 and the final stages are one-hand tasks. During these stages, the screen displays precautions for each stage depending on the initial task settings that the user has preset. The user can progress to the next stage by confirming the information, or respond to the request for reviewing details of the previous stage. Data regarding safety precautions are developed based on the preexisting work safety guide.

Stages 5 to 9 are two-hand task sections and thus the user cannot use the App. In these stages, the regular screen displays precautions regarding the tasks. As in cases of emergencies, the regular screen also displays information regarding type of accidents, escape routes, etc. to ensure that the user's safe and prompt evacuation. To provide such information, it is seriously needed to set up a system to keep the App. in sync with the main server for the work site.

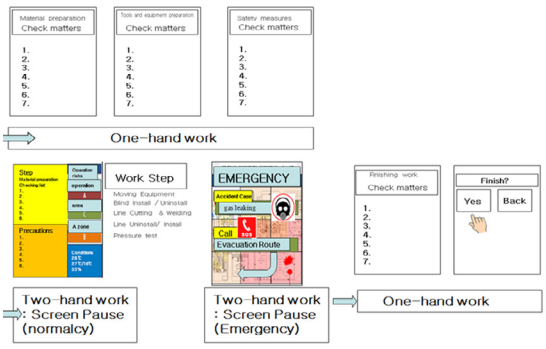

Figure 1. Example of App. Use – focused on the pipe work.

3. Icon Design, App. Design based on UI/UX

The App. should have structurally simple design using intuitive images for the people who are not familiar with

Table 1. Survey participants. (unit: %)

Gender	Male	Female			
	75	25			
Service Year	1~5 years	6~10 years	11~19 years	more than 20 years	
	31	**9**	**38**	**22**	
Age	**20~29**	**30~39**	**40~49**	**more than 50**	
	27	**13**	**50**	**10**	
Job	**Production Worker**	**Production Manager**	**Technician**	**Technical Manager**	**Others**
	6	0	39.6	25	5

digital devices, foremost. Given the low smart familiarity of gas workers and the gas working environment, the first stage to design the App. is surveying and comprising the intuitive image that is easy to recognize. Images required for gas safety management smart phone App. include intuitive warning colors, images for notifying emergency situations, gas leakage, indication for safety work, areas of caution as well as sensors including hygrometer and pressure gauge, LPG used as the major hazardous material, acetylene, hydrogen and work images.

A total of 60 gas workers responded to the survey. The participants' profiles are as Table 1.

We utilize quantitative analysis method to analyze the survey and the outcome of analysis is as shown Figure 2.

The initial derivation of user requirements of gas workers focused on professional advice on characteristic of field worker is as follows.

1. Precise arrangement of content: Gas workers are less friendly to smart devices. Therefore, provide easy access to required content in Information Architecture (IA) of the application.

2. Design with readability: By considering the easy use by workers and characteristics of the application, it was surveyed that operating speed is important. Therefore, adjust the image levels[8]. The detailed principles for enhancing readability are as follows: Compatibility rule, comfortable spatial arrangement and motion compatibility[9].

3. Low depth design: By considering 1. and 2., design to quickly and easily reach the desired content by worker.

4. Secure user convenience: This application is aimed to help workers. To help them gain required information by taking the minimum movements, take consideration on both the screen display design and application design.

N0	Research Topics	Results
1	the indication sign for "Danger."	the red color
2	the degree of "Urgency"	a kinetic image
3	The image for "Gas Leak situation."	a gas mask image
4	The image for "Operating safely" sign	the "Okay Sign"
5	The image for "Careful"	the "Exclamation Mark" image.

N0	Research Topics	Results
6	temperature sensor	
7	anemovane	
8	pressure gauge	
9	CC TV	
10	temperature-humidity sensor	

N0	Research Topics	Results
11	LPG sensor	
12	Acetylene sensor	
13	hydrogen sensor	
14	Tank	
15	operation	

Figure 2. Icon Design.

Menu buttons and information in one page shall be designed into a single column with 5-7 items. According

to Hick, to minimize the selective response time of human, the number of alternative selection for performing work needs to be minimized. Therefore, IA reflecting this is needed[10].

According to Fitts' law, to reduce operating time, the clicking or operating area needs to be expanded as much as possible. Therefore, reflect this in determining button size, location and color[11].There has been a research that found out that pie menu offers shorter movement distance and wider selection area than list menu, hence reducing the operation time. However, in this case, it is more effective to use familiar methods to workers. Therefore, it is ideal to determine the button alignment from list menu or pie menu through survey[12].

When designing an application, verify and reflect the feedback function and error prevention function for informing users on what function is being operated, and whether the conceptual models of developer and user match through a field test after development for the final development[13].

For the overall page design, allow enough space for buttons without dividing into upper and lower columns to prevent potential errors, and at the same time, arrange warm colored buttons in dark background to enhance readability. The background color was designed by considering the research that defines colors preferred by workers in their middle ages are blue and gray tones of a low chroma[14]. Also, as many of gas workers wear gloves, the motion was designed to slide the overall page rather than providing sliding buttons to prevent errors.

Also most gas workers are designed in a horizontally longer oblong shape. Hence, for this application providing the overall information on worksite, the page turning function is mandatory[15]. This needs to be provided without a separate icon as bellows, Figure 3.

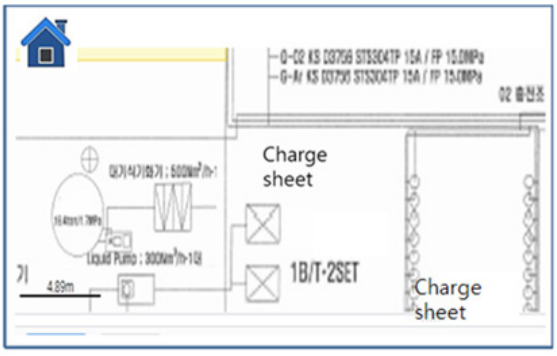

Figure 3. Screen Display and UI/ UX 2.

Information provided in conjunction with the main system consists mainly of work risk level, risk level of unit region and sensor monitoring. As Figure 4, the risk level of unit region classifies the risk level of each region by color according to the location of each risky facility and material. This information can be delivered intuitively through icons developed earlier[16].

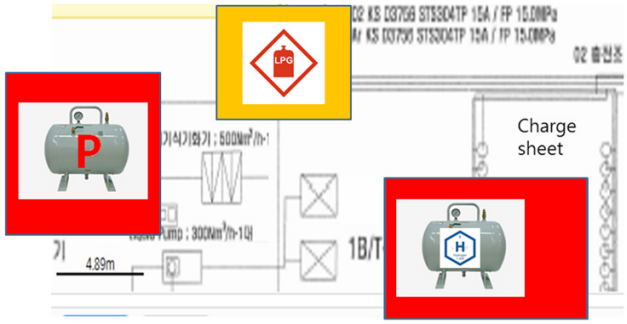

Figure 4. Risk of unit region.

Work risk level shows the basic information of given task, risk elements and safety procedures by each work stage and information on accident response guide.

In this case, an abundant amount of information is provided on screen. However, as it is considered that all information is needed at this stage, rather than filtering out information, it is more appropriate to develop a display with high readability. Therefore, we have designed the current internet news article page with black texts in gothic fonts in white background as the default[17].

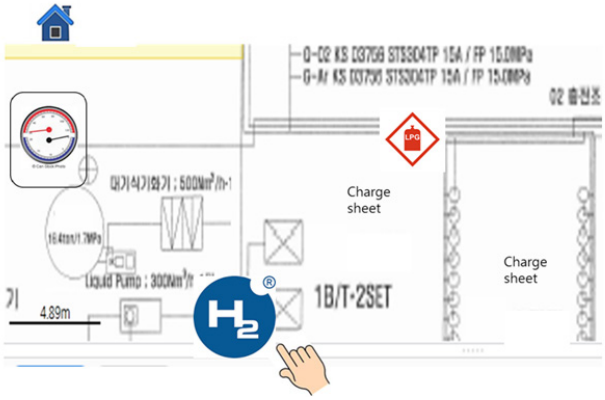

Figure 5. Sensor monitoring information

Finally, sensor monitoring information can be provided by using icons with high readability as in unit region information. Users can zoom in/out and move

with fingers, or display information relevant to each icon by clicking each icon image as shown in Figure 5. The mobile App. design we propose is as bellows, Figure 6.

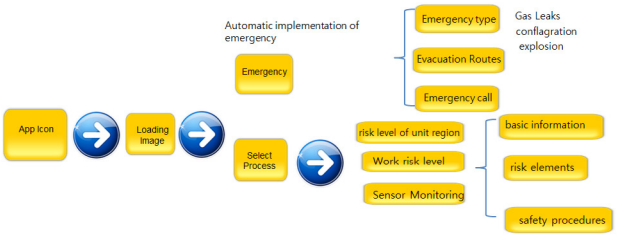

Figure 6. App. Scenario.

4. Conclusion

Further research should be conducted on the following: First, in case of tasks that have precaution alerts, sections where frequent operational errors occur must be identified. This should be preceded by a close tracking of the operator's behavioral patterns through interviews, questionnaire-based surveys, etc. And surveys showed that the gas industry involves a lot of two-hand tasks, such as handling heavy equipment. Thus it is necessary to explore various interactive devices that can sync with the mobile App.

Furthermore, a prototype of the App. will be developed through collaboration with a risk map developer. The prototype will be continuously revised with feedback from operators who use the App. in the field. The process and results will be reported in following researches and papers.

5. Acknowledgements

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