Urgent Communication Method
for Deaf, Language Dysfunction and Foreigners

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Abstract. This paper discusses a communication method with smart phones for deaf or language dysfunction people as well as foreigners at the urgent time of sudden sickness or fire in order to report to the nearest fire station. Such method is originally proposed by a hearing impaired person. Their appearances are the same in the daily life. However at the unexpected situation, they will be suddenly in trouble at such the occasion of disasters or accidents. The previous research, which was introduced at ICCHP 2010, proposed a method to create pictograms or icons referring to multiplex local sign languages with Multivariate Analysis (MVA). Those outcomes are drawn on a booklet to be held a dialogue between deaf and hearing people. This time they are implemented on a smart phone. Normally the usability is measured by the effectiveness, efficiency and satisfaction. Then this time the outcome is measured by the efficiency, that how quickly to report the fire station nearby. The evaluation gathering deaf people and a foreigner found that this method is about three times quicker to do the first report to the station comparing with text messaging on a smart phone.

Keywords: Inclusive Media, Context of Use, Computer Human Interface, Human Centred Design, Sensory Evaluation, Tablet Terminal.

1   Introduction

At the disaster of East Japan Earthquakes and Tsunami on 11 March 2011, there were nearly 15,000 victims including disabled people. In such a situation even phlegmatic person may upset and be lost cognitive and behave like dementia. Looking at the disaster the important information could not reach to the residents on the spot. This must be particularly serious problems for disabled people such as deaf, language dysfunction or foreigners who are difficult in bi-directional communication [1].

To solve such issues a booklet titled "SOS card" was produced and about 6,000 copies were distributed to the public facilities including local fire stations. The booklet is gathering pictograms and icons just menu like. Hearing impaired people have simply to point them at the time of communication [2,3]. There are about 790 fire stations in Japan and once equipped FAX machines for such people. Recently

introducing a tablet terminal such as a typical smart phone is quite useful and improves their daily life. Considering such background, the "SOS card" is to be implemented on the smart phones such Android terminals [4].

Recently modern Information and Communication Technology (ICT) expands opportunities to implement accessible applications used by disabled people as inclusive media such as a tablet terminal with full functions; high speed processing, large memory size and remote communication. Previously those applications were rarely existential or quite expensive, however nowadays they are accessible with less expensive or sometimes free of charge.

2   Survey of the Previous Work

This paper is a successive research of "Context Analysis of Universal Communication through Local Sign Languages applying Multivariate Analysis" which was presented at ICCHP 2010 in Vienna [5]. The previous paper discussed a method to create pictograms or icons referring to multiplex local sign languages with the concept of context of use on dialogue with Multivariate Analysis (MVA). Since pictograms or icons are universal communication tools, Human Centred Design (HCD) [6] and context analysis by Persona model by Alan Cooper [7] are applied in the research. HCD is based on the context of use which is organized by four factors as user, product, task and environment in use [8]. The purpose of the previous research was to figure out a method to create meaningful pictograms or icons referring to several local sign languages (SL). The sign language is basically a communication method from one person to the other for hearing impaired persons.

The first step is to create two Personas with applying the Persona Model under HCD. A created Persona is a deaf person in a situation where he suffers a sudden illness while commuting in the morning, and is carried to the hospital by an ambulance. The next step is to extract words that are fundamentally essential to the dialogues of the scenarios [9]. The research is initially focused upon creating pictograms or icons to make dialogues since the fundamentals of sign language are hand shape, location and movement. This research references to a collection of animation figures consists of seven local sign languages of American (ASL), British (BSL), Chinese (CSL), French (FSL), Korean (KSL), Japanese (JSL), and Spanish (ESL).

Then the Correspondence Analysis of Multivariate Analysis (MVA) by statistic software; Statistical Package for Social Science (SPSS) is applied [10,11]. They are plotted that such as similar local sign languages are to be plotted closely on a plane [12]. In the characteristics of Correspondence Analysis, the subjects who have general and standard ideas are positioned in the centre, whereas those who have extreme or specialized ideas are positioned away from the centre. Following to the cycle process of HCD, the original designer is asked to summarize and design an animation like pictogram showing a few exclusive local sign languages by referring to the outcome by the sensory evaluation mentioned above.

The final step was validation of the outcome by the same manner as the first sensory evaluation step 4 above, and MVA is once again performed. The outcome including the newly designed pictogram is plotted with other seven local sign languages in order to prove and measure whether the newly created pictogram represents of the cluster.

The newly designed one will have represented related sign languages since it is plotted close to those sign languages. Whereas the other sign languages were plotted further down. In order to prove the outcome, Supplementary Treatment of MVA by SPSS is applied with adding newly designed one to the seven sign languages. These deployments of the plots are similar in seven and eight sign languages experiments.

In the previous research the followings are concluded:

- Newly designed animation pictograms are all positioned in the centre of the related local sign languages cluster.
- Even though almost of the subjects are different at the first and second experiment, the general outcome plot patterns hold similar patterns in space.
- In oriental sign languages of Japanese, Chinese, and Korean tend to be plotted closely together.

Through the proposed method, the relationship between selected words and local sign languages are initially explained by sensory evaluation of the subjects.

3   Implementation over the Tablet Terminal

The previous research outcomes are drawn by pictograms and icons with help of MVA. For instance ache portions are drawn in two dimensions. Ache depth and severe pain are in the third dimension. The hearing impaired and people will simply touch the designated pictogram or icons to communicate the remote support people in such urgent situation by ubiquitously carrying the tablet terminal with touch panel. The modern tablet terminals are equipped inclusive media with the following functions; Tap to select, Double tap to do scaling, Drag to jump, Flick or Swipe to move next page, Pinch in/out with double fingers, accelerate sensor to position upright, Photo browsing to display icons or pictograms, Backlight for dark place usage, GPS and Wi-Fi function to download the new contents.

Following to the human centred design process, the first approach is to observe the activities of telephone exchanges at command console in a fire station and analyzed the dialogue process at urgent situations in Figure 1 [13]. In general most of telephone reports are either fire conflagration or sudden illness. Then the following five processes to implement on the tablet terminal were extracted for the communication between a reporter in trouble and a lifesaver.

1. Registration of the face information of the reporter on the tablet terminal before urgent situation.
   There are plenty of preparation time to register such information; Name, Address, Age, Gender, Classification of the Disability, e-mail Address, Date of Birth, Anamnesis, Primary Care Hospital, and the Relatives Information, etc.
2. At the exact moment of urgent report.
   The most important matter at this moment is to report promptly to the nearest fire station. Applying the previous research result, selected words are drawn with pictograms or icons excluded time consuming text input to be easily used by hearing impaired people by simply to click them. The report includes exact GPS data of the location in order to find the reporter promptly by the lifesavers.

3. At the time of fire engine or ambulance dispatching to the location
Since the hearing impaired people often complain this dispatch time without any communication. To ease their worries, bi-directional devising is prepared.

4. At the time to find the reporter location
Many injured people are under the rubble in East Japan Earthquakes in 2011 and lifesavers were difficult to find out them. Since deaf people must face much more difficulties, a torch and whistle functions to let notice are implemented on the smart phone.

5. Dialogue on the spot
Even at face to face communications with the lifesavers after reaching at the spot, such pictograms and icons will be useful since normally a few lifesaver understand sign language.

The product is referring to the user experience of usability by elderly people on Automated Teller Machine (ATM) considering the similarity in low cognitive at emergency situation and elderly people behavior [14,15]. There are three points in the guidance to design a tablet with a touch panel:

1. Make limited choice referring to "Magic Number" by G.A. Miller [16]
2. Change the screen explicitly
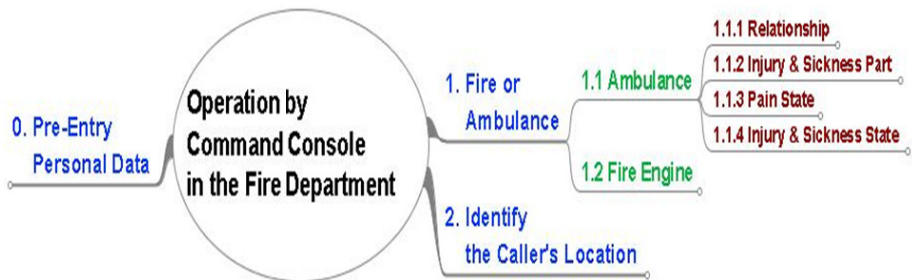3. Make confirmation with step by step operation

Fig. 1. Telephone exchanges at command console in a fire station and analyzed the dialogue process

4   Evaluation of the Produced Contents over the Tablet Terminal

A proposed application on the tablet terminal was evaluated by hearing impaired people in the manner of the usability test based on working hypothesis. The following six tasks were prepared to compare with applications between on the tablet terminal and on personal computer (PC). Those tasks requested the subjects virtually to call ambulance and fire brigades. The evaluation test was performed by seven hearing impaired participants and a foreigner (subjects) in total. All experiment instructions were informed to hearing impaired subjects by a sign interpreter. Subjects were allowed to use memo notes.

- Task-1: Filling out the pre-entry personal data
  A trial to fill out the personal data sheet such as name, address, age and one's history of disease, etc.
- Task-2: Fire report by the tablet terminal.
  This scenario is that "The forest is on fire. The reporter recognizes a flame but no fume. The one is safe since the one is away from the fire spot. There is no injury. Please help".
- Task-3: Fire report by text of e-mail with PC
  The scenario is "This building is on fire. My floor is different from the fire spot. The reporter cannot recognize flame but fume. There are some injuries. Please help".
- Task-4: Ambulance request by text of e-mail with PC
  The scenario is "Please call ambulance since the reporter was run over by a car. One is middle aged male. The reporter is conscious but the leg is broken with blooding. It is quite painful. One have once experienced fracture and took to surgery. Please deliver an ambulance soon".
- Task-5: Ambulance request by the tablet terminal
  The scenario is "The reporter's daughter is urgent sick. She is grown up and pregnant. She might be preterm birth. She is conscious but appeals her savior pain in the belly. She was once suffering from gallstones. Please deliver an ambulance soon".
- Task-6: Interview with filling out questionnaires
  After the evaluation the subjects are asked about usability of the tablet terminal with Semantic Differential (SD) Method.

The results must be analyzed under "the Context of Use" whose result is measured by the effectiveness, efficiency and satisfaction. This evaluation opportunity focused particularly on the efficiency with comparing two options between applying the tablet terminal and without it by text messaging. The efficiency result found that the first report time to reach the nearest fire station is three times quicker by using the terminal. The interview after the evaluation, many hearing impaired people pointed out that this tablet terminal service will ease their predicted mental concern at the urgent situation. This relates the basic concept of Satisfaction in the Context of Use or User Experience (UX).

5   Conclusion and Future Work

Currently about 20 screen contents on the tablet terminal are prepared by the Software Development Kit (SDK) of MIT APP Innovator and distributed onto Android touch panel terminal through DeployGete for the evaluation. The hearing impaired users are simply tapping the pictograms or icons on the sequences on the screen. The screen transition processes are based on the telephone dialogues of the command console of the Kasuga Onojo Nakagawa Fire Department in Kyushu Prefecture in Japan. Then the process is analyzed and drawn by MindMap software. The tablet terminal includes the cognitive design experience on ATM for elderly people since under such an urgent situation people would be upset and hard to communicate and behave a cognitive decline.

The research development of the tablet terminal is once started from the basis of standalone and now it is possible to connect to the remote lifesavers at fire station by Internet technology. The remaining issues are that currently it is implemented solely on the Android mobile terminals but it is necessary to support Apple-iOS users. The political issue is that the tablet terminal must be delivered free of charge for everybody. A day will come that this tablet terminal as accessible media will replace the commonly used FAX machines for particularly hearing impaired people, dysfunction, elderly people and foreign people.

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