SMMAPS: Scenario-based Multimedia Manual Authoring and Presentation System and its Application to a Disaster Evacuation Manual for Special Needs

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Abstract
When a disaster strikes, people must make important survival decisions. They must clearly understand the situation and decide what to do immediately. A well-designed disaster preparedness manual would facilitate making the best choices. This paper begins by specifying drawbacks with currently available manuals from the standpoint of people with disabilities or the elderly; these drawbacks include communication or physical accessibility problems and content accessibility or the person's ability to comprehend the situation. We propose a system for producing a disaster evacuation manual equipped with accessible, versatile materials to address various needs and a variety of disastrous situations. We describe its prototype implementation using the preliminary results of a field test.

Keywords
Manual, People with Disabilities, Usability, Disaster

ACM Classification Keywords
I7.2. Document and text processing: Document preparation. K3.1 Computers and education: Computer uses in education.

Introduction

Importance of self-made decisions in disaster evacuation

We often suffer extensive damage from natural disasters. Recent examples include the Great Hanshin earthquake (1995, Japan), Indian Ocean earthquake (2004, Asia), and Hurricane Katrina (2005, USA). Various measures are developed in each country or community to survive disasters, such as the creation of FEMA, The Federal Emergency Management Agency, in the USA.

It is commonly believed that there are two factors involved in surviving disasters: *social support* and *self-made decisions*. Social support has played an important role in survival in many previous disasters. However, social support does not always address individual needs; self-made decisions are always necessary during a disaster evacuation period. Social support may also have a time lag. Self-made decisions are particularly important immediately after a disaster occurs.

Knowledge of behavioral procedures

Appropriate self-made decisions require that people have knowledge regarding behavioral procedures in order to decide what to do to survive. This knowledge enables them to apply various information to their behavior; this information includes appreciation of the current situation, determining the course of the evacuation procedure, assessing the reliability of the information, and understanding the roles of various organizations that are participating in the evacuation activity. Without well-developed procedural knowledge, people may make bad decisions or fail to react to an undesirable situation. We firmly believe that many of the people that live on the western coast of northern Sumatra could have escaped the tsunami if they had known and understood that they needed to evacuate to high ground when earthquakes occurs, due to the possibility of a tsunami.

Manuals as a source of knowledge

A disaster evacuation manual is a primary source of knowledge in disaster preparedness. Natural disasters such as earthquakes or typhoons occur frequently in Japan, and various manuals exist and are distributed by municipalities.

We examined a number of currently available disaster evacuation manuals and concluded that they have accessibility problems. The problem is serious for people with special needs, such as those with disabilities and the elderly. More accessible manuals are necessary to provide appropriate knowledge to facilitate self-made decisions.

Purpose and outline of this paper

This paper proposes a multimedia manual production system, called SMMAPS, which stands for Scenario-based Multimedia Manual Authoring and Presentation System. SMMAPS supports authoring and distributing accessible disaster evacuation manuals to people with disabilities. This paper includes the following sections: the *Problems with Current Manuals* section proposes that the currently available manuals are inadequate for people with special needs and describes the features of

an improved manual; the *Outline of SMMAPS* section proposes SMMAPS that is a system capable of producing such manuals; the *Prototype* section describes a prototype manual produced by SMMAPS.

Problems with Current Manuals

There are several methods available to enable people with special needs to learn procedural knowledge, such as multimedia educational materials for children or people with intellectual disabilities and closed captioning or sign language in video materials for those with hearing difficulties. However, we suggest that these learning tools are not produced in a manner suitable for developing disaster evacuation manuals for people with special needs. The following subsections further explain this issue.

Accessibility problems

The presentation method for procedural knowledge differs significantly from person to person. There are two issues involved in the form of the presentation, communication accessibility and content accessibility. The former is related to whether the medium used to communicate, for example, sign language, narration, images with specific abstractions, or maps, can be comprehended by the person using the manual. The latter concerns whether the content, such as "you must evacuate to high ground when an earthquake occurs due to the possibility of a tsunami," is properly understood by the person.

An example of communication accessibility is as follows. Closed captioning is a widely adopted solution to accessibility for people with hearing difficulties. Many TV programs use this technology to assist hard-of-hearing people with understanding the content. However, we are concerned that a hard-of-hearing person with an intellectual or language disability would have difficulty utilizing such captioning and may experience a problem understanding. Those people require a form of presentation that does not solely depend on closed captioning but is also accompanied by sign language and/or more easy-to-understand captioning.

The following is an example of content accessibility. People in Japan learn from standard disaster manuals that "you must evacuate to high ground when an earthquake occurs due to the possibility of a tsunami." This rule is very general and it is not immediately applicable as stated. The person in danger must connect the general description "high ground" to an actual place, such as "ABC playing field," before taking action. The content is useless without a specific destination; its content is not accessible. People moving to a new town or those with an intellectual disability may superficially understand the rule but may fail to translate it into a workable solution when it is necessary.

Content accessibility is particularly essential for disaster preparedness, since the rules can be applied only when they are properly understood. There are many situations in which proper understanding cannot be easily attained since it requires considerable inferences to relate a general rule to the present environment and disaster situation. We maintain that the current learning environments do not sufficiently consider content accessibility.

In summary, a disaster evacuation manual must have both communication accessibility and content accessibility designed for specific users.

Flexibility problems
Manuals may be used by various people and for various situations. Their contents must satisfy the accessibility requirements described above. Considering the breadth of potential disastrous situations, which differ among locations, and the variety of special needs, the range of necessary manual contents is staggering.

The currently available learning environment was created by considering specific individual needs. Applying this method to the creation of a disaster evacuation manual would result in an attempt to design a manual based on individual needs. This is not practical, considering the diversity of needs and disaster situations. The current manual production method is not sufficiently flexible to produce a disaster evacuation manual.

A solution
A solution to the accessibility problem and the flexibility problem could be described as follows: A database that stores separate pieces of manual contents and integrates them according to a specific individual need and disastrous situation would satisfy the accessibility requirement. For example, the database would store multiple representations for the single rule "Evacuate to high ground when an earthquake occurs due to the possibility of a tsunami," which would include various presentations, such as text captions, narration, illustrations, a photo image with CG retouching to designate an actual location for the evacuation destination, sign language, and a map of the location.

The presentation levels could be both concrete and abstract. A manual could be created by integrating the contents in the database when the usage situation is defined in terms of a specific person with a specific accessibility requirement and a specific disastrous situation, to provide better understanding of the behavioral procedure.

Outline of SMMAPS

This section describes a manual production system, SMMAPS, which solves the accessibility problem and the flexibility problem. Figure 1 depicts the outline of SMMAPS. SMAPPS manipulates the manual contents at three levels to solve the flexibility problem: *materials*, *scenes*, and *scenarios*. The communication accessibility problem is solved by preparing materials that meet individual needs. The content accessibility problem is solved by scenario and scene authoring, which enables the manual creator to adjust the manual contents such that the learner can properly understand the behavioral procedure that the manual contents describe.

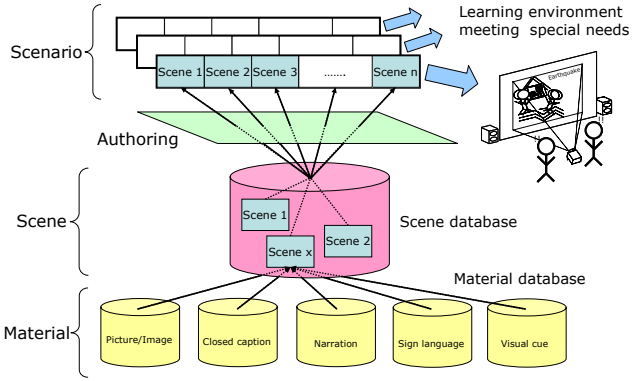

Figure 1 Outline of SMMAPS.

The materials include pictures and images, closed captions, sign language, and narration, and are used to define scenes. Individual elements are preserved in the material database. A variety of materials is prepared to meet various needs; for example, the caption level could be easy or standard, the narration speed could be fast, standard, or slow, the sign language style could be Japanese sign language or signed Japanese.

A scene represents a rule, such as "Don't forget to put out your fire when an earthquake occurs," with additional information such as the caption level, narration speed, and sign language style, which are available in the materials database. Scenes are preserved in the scene database.

Scenes are crucial devices to satisfy accessibility. Scenes with closed captioning and/or sign language could be used for communication accessibility for people with hearing difficulties, and scenes with narration and closed captioning with easy-to-understand words could be used for people with intellectual disabilities. Scenes with explanations of how to evacuate from a tsunami could be used for content accessibility for people living on beachfront property, and scenes with explanations of how to evacuate from a hurricane could be used for people living in a hurricane-prone area.

A scenario is a sequence of scenes that represents a procedure, with a theme such as "What should you do when an earthquake occurs in your town?" People could learn behavioral procedure from these scenarios.

A typical use of SMMAPS to create a disaster evacuation manual (assuming the database is ready) is as follows. 1) Specify the learning purpose. 2) Specify the learners' life environment. 3) Specify the level of support, e.g., necessity of sign language and language understanding level. 4) Define an evacuation scenario to achieve the learning purpose. 5) Select scenes according to the scenario. 6) Select materials with which to present the scenes.

Prototype

A prototype disaster evacuation manual was created using SMMAPS. The manual is written in SMIL (Synchronized Multimedia Integration Language) [1].

The manual was made for people in Urakawa town, Hokkaido, Japan. People in the town constantly face the danger of tsunami because they are located on the coastline and earthquakes often occur. Despite their importance, the current manuals are reportedly not understandable.

We believe that a lack of content accessibility causes this problem, in that people need more clear representation of the dangers in their zone. We investigated the dangers along an escape route in this zone to create an evacuation scenario to meet this need.

The prototype is basically a transformation of the currently available disaster evacuation manual, which describes evacuation procedures in very general terms and uses illustrations, some of which are relevant and others not, into a SMMAPS multimedia manual whose contents have both communication and content accessibility. The scenes are presented by using photos of various places in Urakawa town that can be easily recognized by the user along with a realistic disaster

image retouched by CG. Sign language and a narrative explanation are added to each scene.

A screenshot of the prototype is provided in Figure. 2. Pictures and images, closed captions, narrations, sign language, and visual cues (to guide the reader's attention to an important part of the pictures/images; see [2]) were used as materials. The manual is available on the Web (http://unit.aist.go.jp/humanbiomed/projects/aist_rehab_joint/english/index.html).

The manual was distributed to the citizens of Urakawa town. The reaction was favorable; the people were deeply engaged by the manual's scenarios and

Figure 2. Screenshot of the prototype, with pictures retouched by CG, a visual cue (yellow rectangle on the picture), closed captioning, map of Urakawa town, sign language, and narration.

appreciated the scenes as possible solutions. They seemed to seriously consider which action to take and very carefully studied the evacuation rules that the manual presented. Their attitude was totally different from that observed when people learn a traditional disaster evacuation manual. They were motivated to acquire concrete and workable procedural knowledge for likely evacuation within a context familiar to them.

Conclusions

This paper proposed SMMAPS and its application to production of a disaster evacuation manual to ensure better self-made decisions. However, SMMAPS is not limited to the use presented in this paper. It could be applied to the learning of procedural knowledge in general, considering specialized information such as how to pass through an airport for the first time, how to arrange furniture, and how to operate a computer. We will continue to develop the SMMAPS environment for further practical use.

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