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HYPERLINKED COMIC STRIPS FOR SHARING PERSONAL CONTEXTS

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Comic strips can be used as a style of visualization on a human–computer interface because they can represent a wide variety of affairs with contexts or time series. This paper describes two systems for sharing personal context as comic strips: ComicDiary and Comic-FOAF-Viewer. Both the systems depict personal experiences or profiles including personal relationships in their comic strips and hyperlinks among related comics based on other characters in the story. ComicDiary allegorizes individual episodes that happen during touring exhibitions by creating a comic from a user's touring records accumulated from personal guidance systems and environmental facts, e.g., social events. For example, a ComicDiary might show a user's personal diary during a Japanese academic conference. The comic describes where the conference was held, the most interesting presentations, what happened, and so on. Exhibitions are places visited by people of all generations. Comic representation of a personal diary with amiable expressions fits such places. The comic strip is automatically generated, composed of 12 frames, and shown as a diary. Users can view their diaries at information kiosks located at exhibition sites. Friend of a Friend (FOAF), which is an XML/RDF application for expressing personal information and relationships, has attracted attention from Web developers because its files can describe human-centered networks such as Social Network Service (SNS). Current FOAF visualization tools utilize graphs or tables; however, it is difficult to represent a variety of relations. Comic-FOAF-Viewer aims to represent the multifarious relations and personal information that FOAF has to offer for surfing interfaces in FOAF networks.

Keywords: Human–computer interaction; comics; storytelling; context-aware; FOAF.

1. Introduction

Human–machine interface designs are often based on visualized information that represents abstract data in a form that facilitates human interaction for exploration and understanding. A quite simple example of the human–machine interface based on information visualization is the expression of a directory tree, which is a structure of files in storage, e.g., hard disk drives. The visualization method, however, only expresses the current status of the tree. If the user wants to grasp the file navigation context, including the status of a directory tree and the navigation history, it may be futile to use current information visualization techniques. Furthermore, they may also fail to visualize context behind decision-making problems and daily life such as personal experiences and complex acquaintanceships.

This paper describes a general architecture that automatically creates comics for expressing complex statements with circumstances and context, including experience, acquaintanceships, and so on. For sharing such circumstances and context, we also propose a method for hyperlinking related comic strips. McCloud defined comic-style expression as *Sequential Art.*[1] In this definition, "art" may refer to illustrations that can describe statements in detail, and "sequential" means that comic-style expression has a timeline not only among frames but also with a frame; thus, such expression can tell a story through rich narrative. To present instances of comic-style expression, we propose two applications for different domains: ComicDiary and Comic-FOAF-Viewer. ComicDiary expresses experiences at an exhibition site in a comic-strip style. This system deals with log data, which is comprised of recorded user activity from ubiquitous environments. Comic-FOAF-Viewer allegorizes human profiles and acquaintanceships represented in FOAF[2] files.

The rest of this paper is organized as follows. The ability of comic-style expression is discussed in Sec. 2, and Sec. 3 describes related works. A general architecture for generating comics is presented in Sec. 4. Sections 5 and 6 explain ComicDiary and Comic-FOAF-Viewer as examples of a system using the architecture. In Sec. 7, we discuss evaluation results and conclude with directions for future work in Sec. 8.

2. Comic-Style Expression

A method of comic expression exists in which a central character appears from start to end as the storyteller. In this study, we assume the generation of such a comic because it suits concise story description for expressing personal experiences and context. Figure 1, for instance, represents an individual experience as a university report written when the author visited a museum. Other students wrote a gnormalh text-based report but she wrote in comic style because she was interested in comic expression and drawing.

Such a comic-style report exhibits the following features:

- It describes her subjective viewpoint.
- Such representation exaggerates her experiences by abstracting and highlighting impressive points rather than precisely recording all actual events.

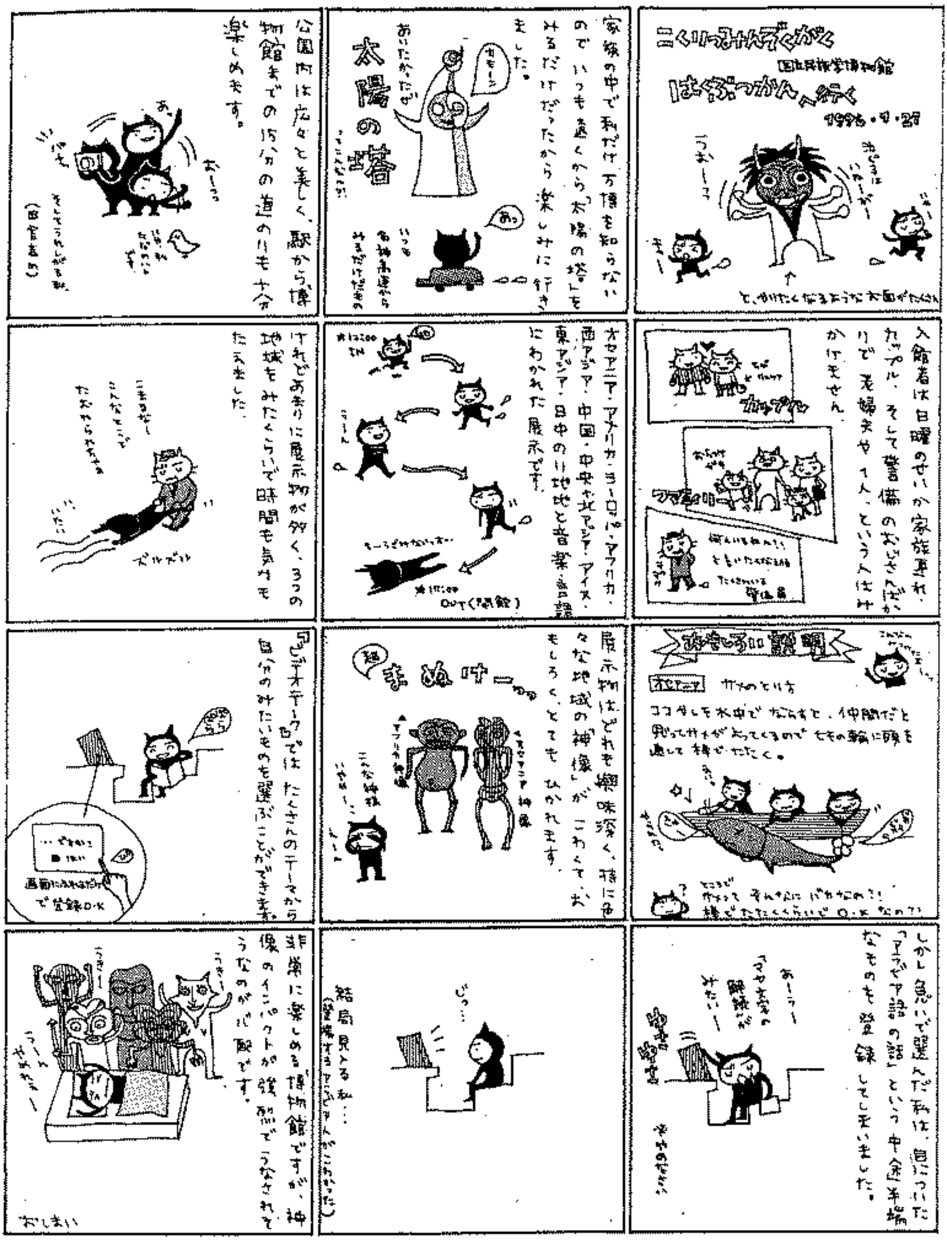

こくりつみんぞくがく
国立民族学博物館
はくぶつかんへ行く
1996・9・27
うまーっ
キーー
と、やりたくなるようなお面がたくさん
家族の中で私だけ万博を知らないので いつも遠くから「太陽の塔」をみるだけだったから楽しみに行きました。
太陽の塔
あいたかったぜ
あっ
いつも名神高速からみるだけだもの
公園内は広々と美しく、駅から博物館までの15分の道のりも十分楽しめます。
あーっ
あ
パチ
入館者は日曜のせいか家族連れ、カップル、そして警備のおじさんばかりで 老夫婦や1人、という人はみかけません。
カップル
ファミリー
警備員
オセアニア・アメリカ・ヨーロッパ・アフリカ・西アジア・中国・中央や北アジア・アイヌ・東アジア・日中の地域と音楽・言語にわかれた展示です。
OUT（閉館）
けれどあまりに展示物が多く、3つの地域をみたくらいで時間も気力もたえました。
ズルズル
おもしろ説明
オセアニア サメのとり方
ココナツを水中でならすと、仲間だと思ってサメが寄ってくるので その輪に頭を通して棒でたたく。
そこまでやって それなのに バカなのか？ 棒でたたくくらいで O.K なのか？
展示物はどれも興味深く、特に色々な地域の「神像」がこわくて、おもしろく、とてもひかれます。
超
まぬけーっ
アフリカ神像
オセアニア神像
こんな神様いやや…
『ビデオテーク』では たくさんのテーマから自分のみたいものを選ぶことができます。
画面にふれるだけで登録O.K
しかし急いで選んだ私は、目についた「アイヌ語の話」という中途半端なものを登録してしまいました。
あーっ
マヤ文明の解読がみたいー
じっ…
結局見入る私…
（登場するおじさんがこわかった）
非常に楽しめる博物館ですが、神像のインパクトが強烈で うなされそうなのが心配です。
うきーっ
うきーっ
おしまい

Fig. 1. Comic strip written by hand as a university report representing experience of visiting a museum.

- The story unfolds based on a timeline, and some frames are contextually related.
- In the comic, not only the exhibition but also other visitors are depicted.
- The comic's appeal is increased by jokes and small notes.

A comic-style report is excellent for conveying such experiences as personal impressions and interests, though it is inappropriate for giving precise details. Actually, in this case, the student's comic-style report was successful, and most readers could grasp her museum experience.

3. Related Works

Many studies on the generation of literary artifacts have been conducted in the disciplines of artificial intelligence and cognitive science. Well-known attempts include the construction of story grammar through story analysis[3] and story generation as a formulation of problem solving and planning.[4,5]

Furthermore, a few researchers have generated comics as an interface. Comic Chat[6] is one IRC client software that represents IRC chat logs as a comic strip with cartoon characters and speech balloons, while Video Manga[7,8] represents a list of video indexes utilizing cartoon panels. In work on Video Manga, important indexes are emphasized as large cartoon panels that enable users to easily grasp summaries. These works apparently chose comic-strip style because it possesses the expressive power to visualize data with a timeline. Neither study, however, considered generating narrative as a stream of cartoon panels, nor did they support general data as sources.

4. Creating Comic Strips and Hyperlinking

4.1. *System architecture*

Figure 2 illustrates the system architecture that generates an interface in a comic style. The system consists of server and client sides. The server side receives requests from the client side and transcodes source data as XML to a story XML. To do

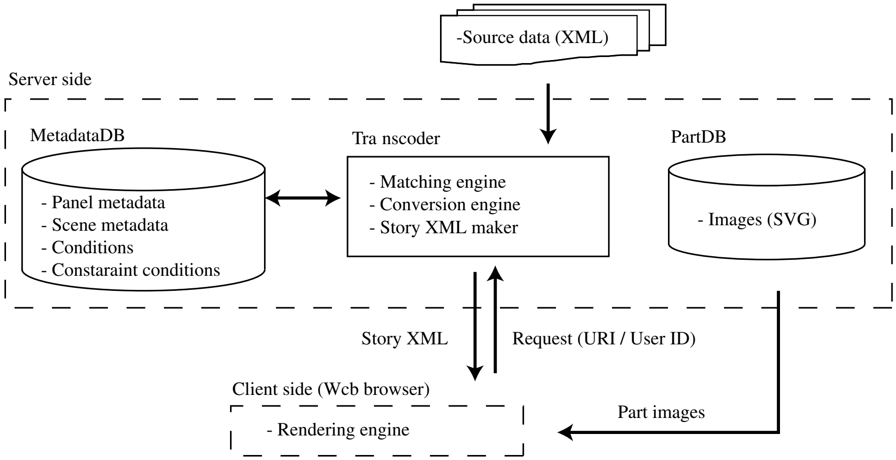


Fig. 2. System architecture.

this, the system uses a kind of transcoder[9] API called “Transcoder”. When story XML is returned from the server side to the client side, the client side obtains real parts of data, renders them, and finally displays them.

The server side contains PartDB, MetadataDB, and Transcoder modules. Except for the Transcoder, PartDB and MetadataDB data are needed for each comic. Each module is explained as follows:

PartDB. PartDB conserves images as parts of the elements of cartoon panels. More than one part per panel is prepared. In systems with the current version, the image format is Scalable Vector Graphics (SVG).[10]

MetadataDB. MetadataDB conserves the metadata that correspond to an SVG file stored in partDB. MetadataDB consists of four tables of panel metadata, scene metadata, conditions for scenes, and constraint conditions. All metadata are based on the JavaScript Object Notation (JSON) format.

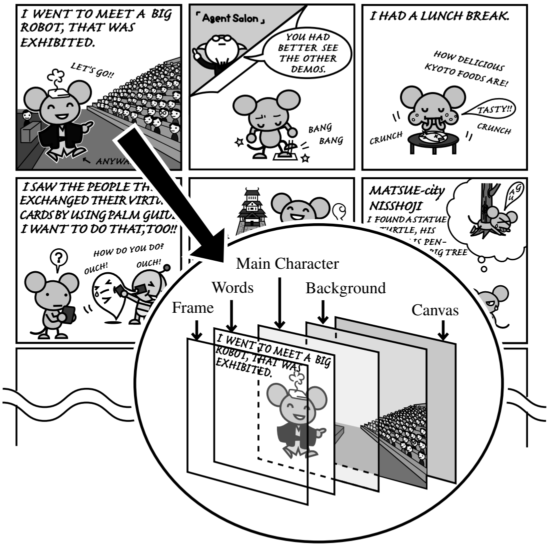
Transcoder. Transcoder is a module that converts the source XML and the part metadata into a story. The story, which is outputted as XML, is called story XML and describes part names that apply to the story and positions of the parts. This module is an API that accepts converted requests from the client side.

To allegorize a story from source data, panel and scene metadata must be prepared. Scene metadata include conditions and constraint conditions. An element of the panel metadata describes three types of information: a name set of the part data in PartDB, anchor areas of link functions, and the conditions of these links. Each panel has its own name. If images of the name sets are combined, a cartoon panel is completed. An element of the scene metadata, which are metadata for scenes, describes the sets of panel names, conditions for existence, and constraint conditions for other scenes. The condition relating to existence describes the condition of the source XML: whether the object scene in question should appear. This condition can use Xpath to indicate points of values on the source XML. The constraint condition describes discrepancies between the object scene and other scenes, and it supports the potential flow of a comic story.

The client side provides a user interface for switching comics, making requests to the server, obtaining parts from PartDB, and rendering an interface in comic style. The left side of Fig. 3 shows an example of a simple rendering case on a frame, where each part overlaps like layers, based on the Panel metadata shown in the upper portion of the right side. The client side then compiles a comic strip by aggregating such rendered frames based on the Scene metadata, shown in the lower portion of the right side.

4.2. *Story generation*

The server side generates story XML files from the source XML file using Transcoder, which is a kind of XSLT engine that can transform the source XML file into a story XML. It is completely different from a general XSLT engine because


I WENT TO MEET A BIG ROBOT, THAT WAS EXHIBITED.
LET'S GO!!
ANYWA
「Agent Salon」
YOU HAD BETTER SEE THE OTHER DEMOS.
BANG
BANG
I HAD A LUNCH BREAK.
HOW DELICIOUS KYOTO FOODS ARE!
TASTY!!
CRUNCH
CRUNCH
I SAW THE PEOPLE TH EXCHANGED THEIR VIRTU CARDS BY USING PALM GUID I WANT TO DO THAT, TOO!!
HOW DO YOU DO?
OUCH!
OUCH!
MATSUE-city NISSHOJI
I FOUND A STATUE TURTLE, HIS PEN- TREE
Main Character
Words
Background
Frame
Canvas
I WENT TO MEET A BIG ROBOT, THAT WAS EXHIBITED.

```
{
  "frameA" : [
     "frame.svg",
     "iwenttomeeting.svg",
     "mouse_A.svg",
     "conf_room.svg"
  ],
 "frameB" : [
    ...
  ],
  ...
}
```

Panel metadata

```
{
  "sceneA" : [
     "frameA",
     "frameB",
     "frameC",
     ...
  ],
 "sceneB" : [
    ...
  ],
  ...
}
```

Scene metadata

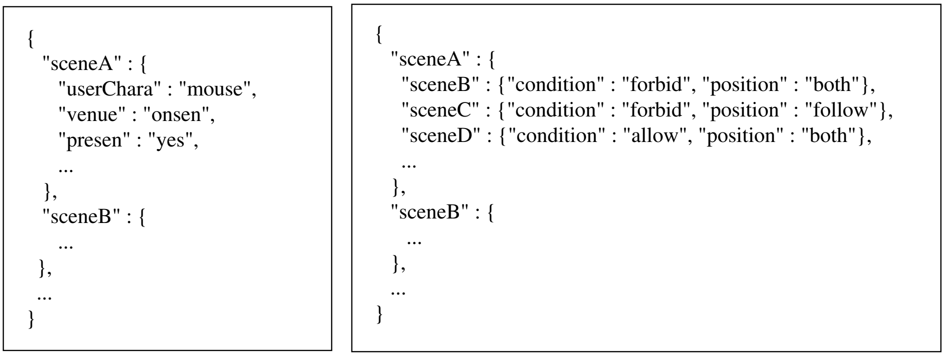
Fig. 3. Left side: Composing and rendering a frame. Right side: Metadata about rendering a comic strip. Panel metadata indicate the SVG file name or URI, and Scene metadata collect the panel names defined in Panel metadata. Scene metadata include the order and position information of each frame.

it makes consistent comic stories among scenes using a knowledge processing technique.

Transcoder, which returns the story XML by referring to the metadata from the source XML files, therefore, does not directly deal with part data but just the metadata. It selects scenes whose conditions are true under conditions that indicate an assumption of node value on the target source XML. After that, Transcoder solves the constraint condition with these selected scenes to produce a coherent story. A sample of the condition metadata and the constraint condition metadata are shown in Fig. 4. If many stories are resolved, the module chooses the one with the highest priority. In ComicDiary, for example, the first generated story with 12 frames is selected because 12 frames fit onto a piece of paper for printing.

4.3. *Linking among related comics*

If users exchange comics as mentioned above, the stories represented in the comics are shared. Exchanging comics printed on paper is the simplest way for that. In this section, we explain another method for exchanging comics that utilizes the characteristics of comic-style expression. In the method, related comic strips are connected. Figure 6 shows a schematic diagram of the method. For example, in ComicDiary, various characters and illustrations are described in cartoon panels that explain a user attending an event. ComicDiary creates a short comic that represents individual



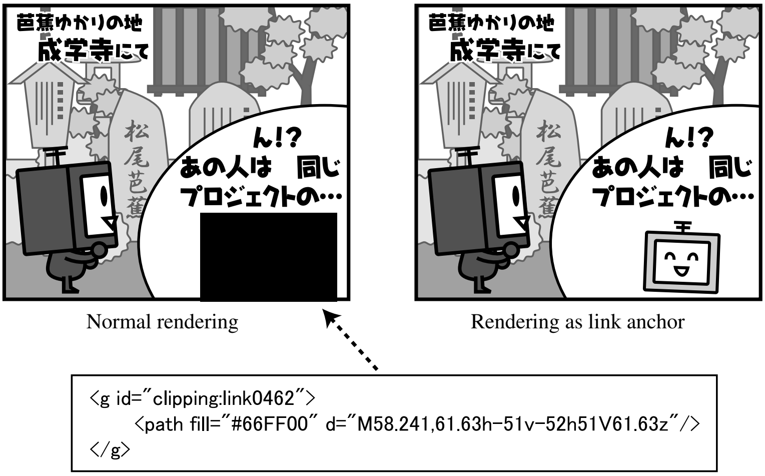
```
{
  "sceneA" : {
    "userChara" : "mouse",
    "venue" : "onsen",
    "presen" : "yes",
    ...
  },
  "sceneB" : {
    ...
  },
  ...
}
```

Conditions

```
{
  "sceneA" : {
    "sceneB" : {"condition" : "forbid", "position" : "both"},
    "sceneC" : {"condition" : "forbid", "position" : "follow"},
    "sceneD" : {"condition" : "allow", "position" : "both"},
    ...
  },
  "sceneB" : {
    ...
  },
  ...
}
```

Constraint conditions

Fig. 4. Sample of condition metadata on scenes. Left side: Conditions of scenes. Right side: Constraint conditions among scenes. All metadata are based on JSON format.



Normal rendering

Rendering as link anchor

```
<g id="clipping:link0462">
    <path fill="#66FF00" d="M58.241,61.63h-51v-52h51V61.63z"/>
</g>
```

Description on SVG file

Fig. 5. Designation of anchor region with *g*-node. Here, "clipping:link***" is a particular name of the node as anchor region.

experiences, and we see a comic that describes the experiences of person A at an exhibition. The comic also describes person B, who passes person A, and person C, who is an exhibition presenter visited by person A. In person B's comic, a cartoon panel identical to the event described in person A's comic might exist. Person B's comic, however, would be different from A's because B's exhibition experience is not the same as A's. Furthermore, if their thinking and preferences are different, cartoon panels of identical events will probably reflect different impressions.

Through these comics, readers can grasp both the relationships and the contexts of the people represented in them. Thus, by reading the stories of all the people

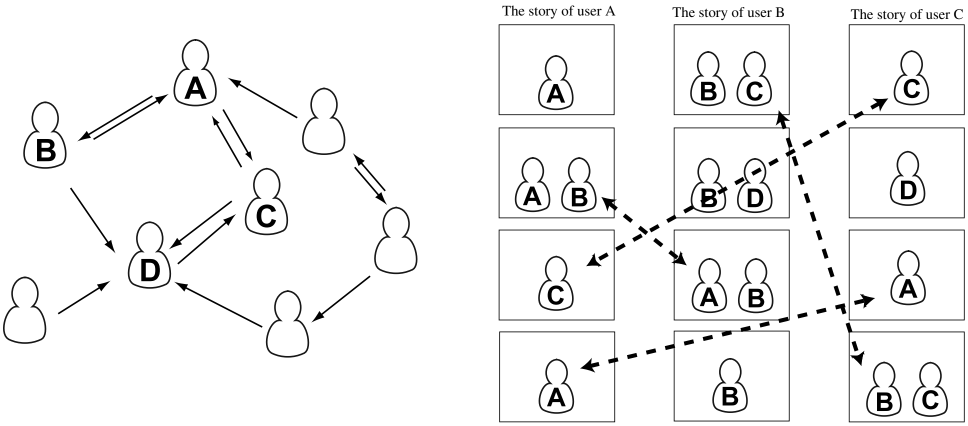


Fig. 6. Linking comic strips at common frames describing identical events. Left side: Sample of network structure of user relationship. Right side: Comic strips of users and links.

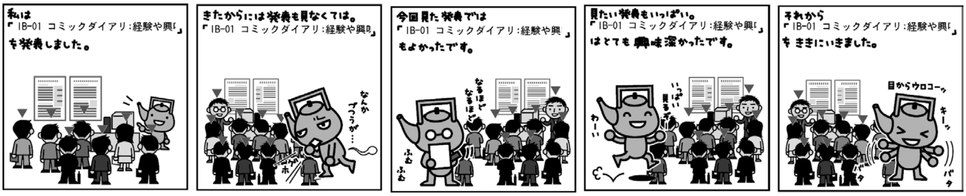

私は
「IB-01 コミックダイアリ：経験や興［」
を発表しました。
きたからには発表も見なくては。
「IB-01 コミックダイアリ：経験や興［」
なんかブツブツが…
ゲホ
今回見た発表では
「IB-01 コミックダイアリ：経験や興」
もよかったです。
なるほどなるほど
ふむふむ
見たい発表もいっぱい。
「IB-01 コミックダイアリ：経験や興［」
はとても興味深かったです。
いっぱい見るぞ
わーい
それから
「IB-01 コミックダイアリ：経験や興［」
を ききにいきました。
目からウロコーッ
キーッ
バタ
バタ

Fig. 7. Six different frames describing an identical event. Although leading character in far left frame is depicted as a presenter in a poster session, the other frames describe characters as audience members. Each character has different attitudes because each user experiences the event with different impressions and context.

related to oneself, one can grasp a context from many viewpoints or perspectives. Figure 7 shows some sample frames that have different aspects, depending on the contexts of users. To realize a reading method, we proposed a structure of connections that resemble web hyperlinks among comics that share panels to make routes for following comics nonlinearly. The link function is useful for sharing stories and their contexts.

Link information is described in the SVG files of parts. Figure 5 shows an example of a link anchor in a frame. The anchor areas are directed as g-nodes of the SVG format. The node to be an anchor is set with a particular name with ID attributes read by the system to decide the link destination by relationships with other stories. In the rendering process, link anchors are set by the referring regions of the nodes and destinations after deleting the g node.

5. ComicDiary System

The ComicDiary system is assumed to utilize user logs from context-aware systems to create comics based on individual experiences. The ComicDiary system has already been launched as an experimental service at academic conferences[11,12] (JSAI2001, SIGGRAPH2001, and Interaction2002) and at an open house exhibition. In the experimental service, the system cooperated with a context-aware system called C-MAP[13] whose logs are used as its source data. C-MAP, a digital assistant system for art galleries, museums, and academic conferences, provides a handheld guidance system called PalmGuide[14] and an information kiosk service. PalmGuide is a portable browser for checking a conference's programs. Its users can rate presentations as "boring", "ok", or "interesting". C-MAP aggregates the ratings as log data in DB, which the ComicDiary system utilizes for estimating user activity and ratings to create user models.

Here, we show a sample scenario to demonstrate how ComicDiary creates individual comics for users at an exhibition. First, the user receives a PalmGuide at the entrance and browses through exhibitions using other C-MAP services, which include a digital business card exchange service, a meeting facilitator called AgentSalon, and so on. The logs of visitors using these services are stored in the DB, which ComicDiary accesses for creating individual comics of users who can browse through their comics on information kiosk terminals at the exhibition site and on Web browsers at home. They can also receive a printed copy of their comic at the site's exit. The story generation process consists of two steps: creating user models and formatting them as a source for sending the results to Transcoder.

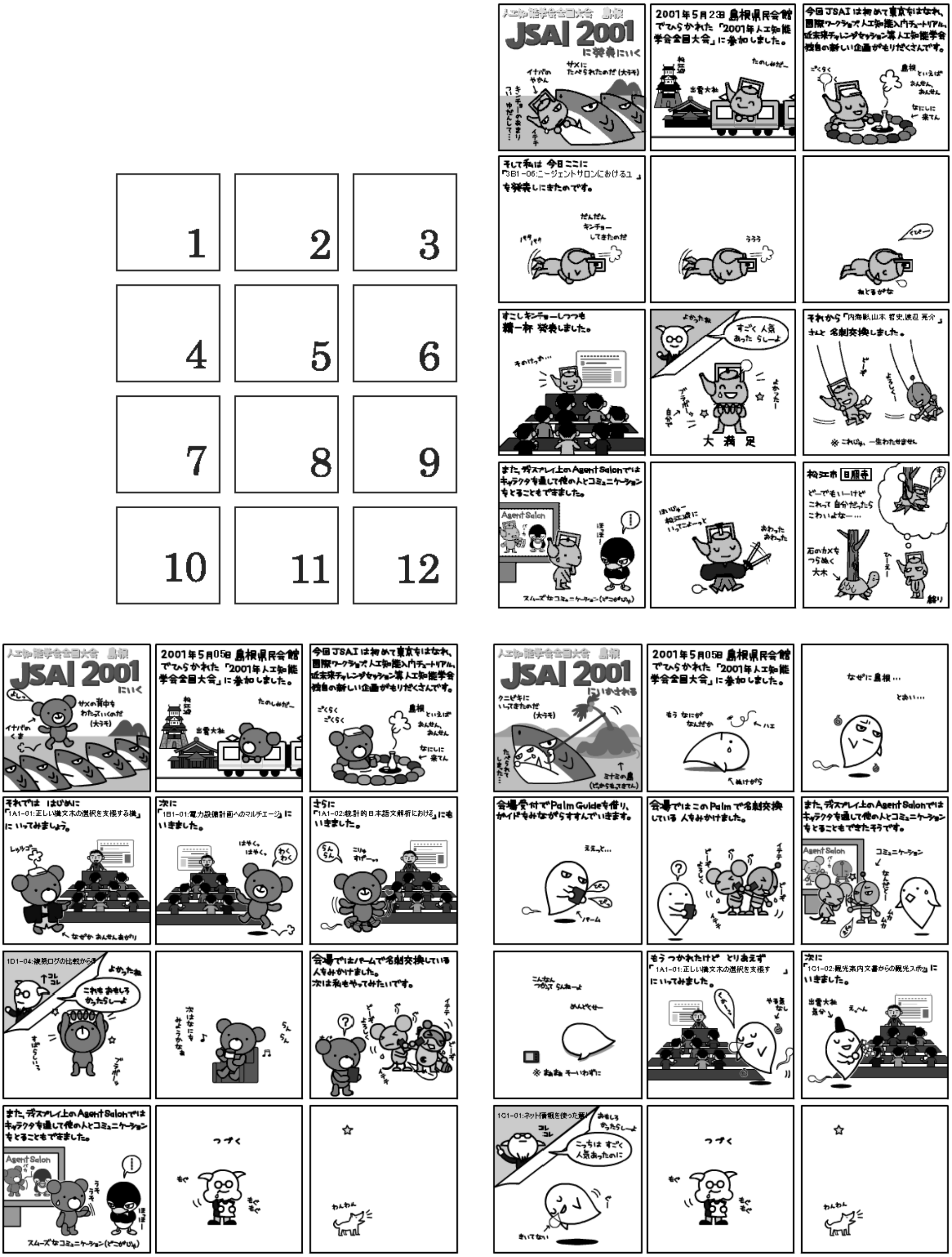
The user-modeling process utilizes the personal and community profiles of each user, and these profiles become the environmental data of all users. They are acquired from the C-MAP's DB. The following shows examples of personal profiles from a conference:

- User age and gender are reflected in the main character.
- Participant type: presenter or audience member.
- Touring history consists of the number of presentations attended and ratings of each. The history is reflected in the impressions and activities in the comic story.
- Interaction history with other users.

Community profiles include the following data used to increase the reality of the story's details:

- Plenary conference events, e.g., receptions and invited talks.
- Information around the conference venue such as tourist information.
- Atmosphere data of the conference, e.g., popularity and ratings of each presentation.

Figure 8 shows examples of ComicDiary for academic conference (JSAI2001) attendees, though the link function is not displayed. In this case, the results of user modeling were roughly divided into three types: presenters, active attendees, and non-active attendees. Active attendees are users who attended many talks and gave them positive feedback. The upper-right comic strip in Fig. 8 is an example of one for conference presenters. The comic, which is read from left to right and top to


1
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12
人工知能学会全国大会　島根
JSAI 2001
に発表にいく
サメに たべられたのだ (大ウソ)
イナバの やかん
キンチョーのあまり ゆだんして…
イテテ
2001年5月23日 島根県民会館 でひらかれた「2001年人工知能学会全国大会」に参加しました。
松江城
出雲大社
たのしみだ～
今回JSAIは初めて東京をはなれ、国際ワークショップ、人工知能入門チュートリアル、近未来チャレンジセッション等 人工知能学会独自の新しい企画がもりだくさんです。
ごくらく
島根 といえば おんせん、おんせん
なにしに ← 来てん
そして私は 今日ここに「3B1-06:エージェントサロンにおけるユ」を発表しにきたのです。
だんだん キンチョー してきたのだ
パタパタ
ううう
ぐぴー
ねとるがな
すこしキンチョーしつつも 精一杯 発表しました。
そのけっか…
よかったね
すごく 人気 あったらしーよ
ブラボーッ
自分で
よかったー
大満足
それから「内海彰,山本 哲史,渡辺 亮介」さんと 名刺交換しました。
どーぞ
よろしく－
※ これじゃ、一生わたせません
また、ディスプレイ上のAgent Salonでは キャラクタを通して他の人とコミュニケーション をとることもできました。
Agent Salon
ほっほー
!!!
スムーズなコミュニケーション(どこがじゃ)
ほいじゃー 松江城に いってこよーっと
おわった おわった
松江市 日眼寺
どーでもいーけど これって 自分だったら こわいよなー…
石のカメを つらぬく 大木
ひーえー
終り
人工知能学会全国大会　島根
JSAI 2001
にいく
よしっ
サメの背中を わたっていくのだ (大ウソ)
イナバの くま
2001年5月05日 島根県民会館 でひらかれた「2001年人工知能学会全国大会」に参加しました。
松江城
出雲大社
たのしみだ～
今回JSAIは初めて東京をはなれ、国際ワークショップ、人工知能入門チュートリアル、近未来チャレンジセッション等 人工知能学会独自の新しい企画がもりだくさんです。
ごくらく ごくらく
島根 といえば おんせん、おんせん
なにしに ← 来てん
それでは はじめに「1A1-01:正しい構文木の選択を支援する機」に いってみましょう。
レッツゴー
なぜか おんせんあがり
次に「1B1-01:電力設備計画へのマルチエージ」に いきました。
はやく、はやく、
わくわく
さらに「1A1-02:統計的日本語文解析における」にも いきました。
らんらん
こりゃ すげー
1D1-04:複数ログの比較から多
コレ コレ
よかったね
これも おもしろ かったらしーよ
すばらしい
ブラボーッ
次は なにを みようかなぁ
らん らん
会場ではパームで名刺交換している 人をみかけました。 次は私もやってみたいです。
どーぞ よろしく
イテテ
また、ディスプレイ上のAgent Salonでは キャラクタを通して他の人とコミュニケーション をとることもできました。
Agent Salon
ウソ ウソ
ほっほー
スムーズなコミュニケーション(どこがじゃ)
つづく
もぐ
もぐ もぐ
わんわん
人工知能学会全国大会　島根
JSAI 2001
にいかされる
クニビキに いってきたのだ (大ウソ)
たべられて しまった…
ミナミの島 (どっからもってきてん)
2001年5月05日 島根県民会館 でひらかれた「2001年人工知能学会全国大会」に参加しました。
もう なにが なんだか
ハエ
ぬけがら
なぜに島根…
とおい…
会場受付でPalm Guideを借り、 ガイドをみながらすすんでいきます。
ええっと…
ぴっ
パーム
会場ではこのPalmで名刺交換 している 人をみかけました。
どーぞ よろしく
イテテ
また、ディスプレイ上のAgent Salonでは キャラクタを通して他の人とコミュニケーション をとることもできたそうです。
Agent Salon
コミュニケーション
なんだとー
ムカ ムカ
こんなん つかって らんねーよ
めんどくせー
※ まぁまぁ そーいわずに
もうつかれたけど とりあえず「1A1-01:正しい構文木の選択を支援す」にいってみました。
くかー
やる気 なし
次に「1C1-02:観光案内文書からの観光スポッ」に いきました。
出雲大社 気分
えっへん
1C1-01:ネット情報を使った新
コレ コレ
おもしろ かったらしーよ
こっちは すごく 人気あったのに
きいてない
ぐー
つづく
もぐ
もぐ もぐ
わんわん

Fig. 8. Sample outcomes of ComicDiary system. Upper left: Order of frames of each comic strip. Upper right: Story for a presenter. Lower left: Active user. Lower right: Non-active user.

bottom (based on the grid in the figure's upper-left portion), starts with a title frame and two introduction frames. The next four frames describe his presentation as his highlight because it is reasonable to assume that it was the most significant and impressive event of his conference experience. The strip in the lower left is an example comic of a user defined as an active attendee. In the comic, the title and introduction frames resemble the comic shown in the upper right. This strip, however, devoted three frames in the second row to attending talks. Another example shown in the lower right is a comic for non-active users. Contrary to the one on the left, this one devoted only two frames to attending talks, and these frame positions are more posterior than those in the upper right and lower left because the comic's goal is to represent the negative aspects of such users.

Figure 9 shows sample images of ComicDiary linked to each other. The ComicDiary on the left represents the story of a visitor to an open house exhibition. He saw a presentation shown in the seventh frame and attended a banquet in the tenth frame. The center strip displays the story for another visitor who saw presentations in the third and ninth frames. In the third frame's presentation, since the visitor coincidentally saw the same presentation as the visitor in the left-hand strip, their comics are connected with a link. The comic on the right is a story about a robot displayed as an exhibition item. The center and right comics are connected to each other because the robot is described in the last frame of the lower-left comic.

6. Comic-FOAF-Viewer System

FOAF based on RDF is a project to represent machine-readable Web homepages, including personal profiles and social networks. FOAF uses "FOAF vocabulary" and its essential class, "foaf:Person", where "foaf:Person" describes private information as a personal profile that consists of a name, an e-mail address, an affiliation, and so on. In addition, "foaf:knows" in FOAF vocabulary describes the personal relationships of acquaintances as "foaf:Person" classes related by "foaf:knows" properties. The project envisions that agents based on the semantic Web will be able to grasp social networks by spidering FOAF files. In the current Web, FOAF is used as the data format for several Social Network Services.

In Comic-FOAF-Viewer, a "foaf:Person" node is allocated to a character. When the Comic-FOAF-Viewer system loads an FOAF file, the system allocates a person who exists as a root of the FOAF tree to the central character and makes a story. Other persons described as "foaf:Persons", which are objects of foaf:knows, are allocated as sub-characters based on conditions in MetadataDB. These sub-characters are illustrated as leading characters in other comics and are linked to the former comic strip.

The left side of Fig. 10 shows an example of a screenshot of the Comic-FOAF-Viewer. The source FOAF files of the example describe the people network of attendees to an academic conference (JSAI2004). These FOAF files use our original "CS vocabulary" that describes attendee type; for example, "cs:chairman" indicates that

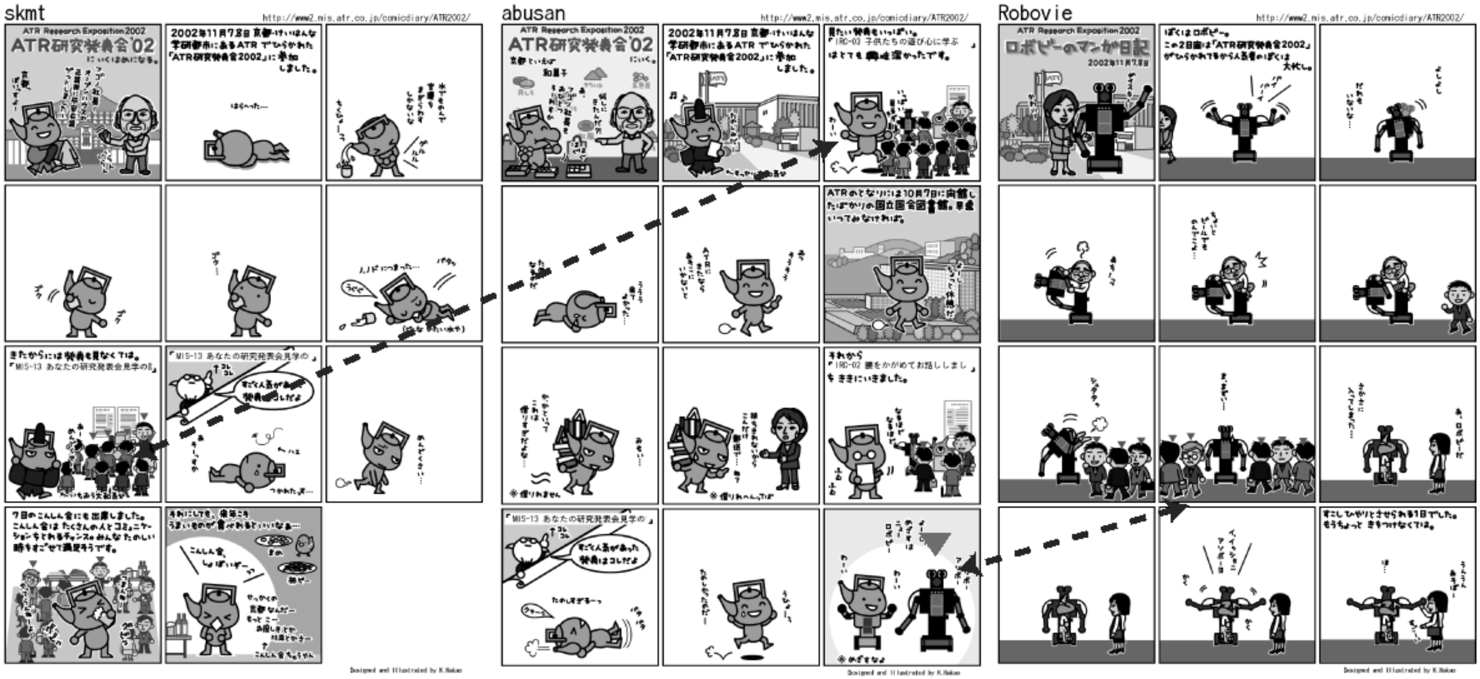
skmt
abusan
Robovie
http://www2.mis.atr.co.jp/comicdiary/ATR2002/
ATR Research Exposition 2002
ATR研究発表会'02
2002年11月7日 京都-けいはんな学研都市にあるATR でひらかれた「ATR研究発表会2002」に参加しました。
ロボビーのマンガ日記
2002年11月7日
ぼくはロボビー。
「MIS-13 あなたの研究発表会見学の」
ATRのとなりには10月7日に開館したばかりの国立国会図書館。早速いってみなければ。
Designed and Illustrated by K.Nakao

Fig. 9. Samples of linked comic strips. Left: Story of a visitor to the exhibition. Center: Another visitor who saw presentations in third and ninth frames. Right: A robot displayed as an exhibition item. These strips are connected through frames representing identical events. There is a red triangle on top of the characters with a link anchor.

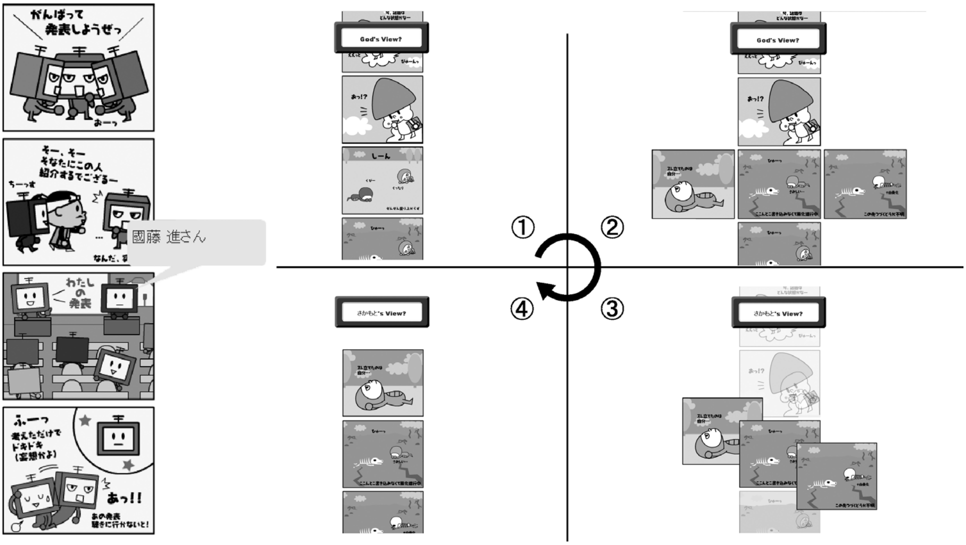

Fig. 10. Left: Screen shot of Comic-FOAF-Viewer. Right: Screen transition when user jumps from one comic to another.

the person is a session chairperson. In the JSAI2004 case, each comic had only four frames because the FOAF files did not have as much information as the source data of ComicDiary.

Each character shown in the comic has a link anchor. Since the Comic-FOAF-Viewer is implemented as the browser for FOAF networks, a smart transition function is present, as shown in the right side of Fig. 10, representing the transition of the screen shot when a user jumps from one comic to another. In this case, the comic strip visualizing an FOAF file is first aligned vertically and read from top to bottom (1). If the user selects a link anchor to another comic strip for an FOAF file, the strip emerges horizontally (2). The strip then transits to the previous one with animation (3), and finally, the position proceeds to the horizontal position (4).

7. User Evaluations

7.1. *ComicDiary service at an academic conference*

The ComicDiary system was empirically tested at the following academic conferences: JSAI2001, Interaction2002, and SIGGRAPH2001. For JSAI2001, ComicDiary cooperated with the C-MAP system, but in the other cases it operated without C-MAP because it was not introduced at those conferences. However, the JSAI2001 version of ComicDiary did not feature the link function. In this section, we discuss expressions of ComicDiary with respect to the JSAI2001 version and with the link function introduced in the Interaction2002 version. Five months after JSAI2001, sixteen C-MAP users completed e-mail questionnaires, which of course is an insufficient number to be used as evaluation data. In this paper, however, we mention them to indicate hints of evaluation tendencies concerning the presentation of ComicDiary.

The question, "Did ComicDiary represent your memories exactly?", is associated with the content of comics. Two people said "exactly", seven replied "fairly well", five responded "moderately", and two stated "not well". Nobody said "not at all". Considering that each comic only had 12 frames, these results are favorable. Ten of sixteen answers were from conference presenters, seven of whom selected "exactly" or "fairly well". That is, seven of the nine who answered positively were speakers, and they had a more favorable impression than only listeners. This suggests that when speakers attend a conference, their most important concerns are their own presentations, and incorporating such scenes into stories is crucial for exact representation of their experiences.

One important effect of ComicDiary is that users often want to show their own diary of their experiences to others. To investigate this effect, we asked, "How many people did you show your printed ComicDiary to?" Three people did not show it to anybody, one showed it to only one person, three showed it to three, one showed it to four persons, four showed it to more than five people, and four users did not get a printout of their ComicDiary. More than half of the users who printed out their ComicDiary showed it to more than three people, suggesting that ComicDiary has the potential to be a medium for sharing user experiences.

The following are the results of using the link function to connect comic strips. The total number of ComicDiary browsings by links was 187 of 539, and the average was 2.9%. We analyzed the navigation paths of the 93 users who went through the links and found that nearly half who did so navigated with a breadth-wise first-order strategy from the comic they browsed first. This shows that users tend to be interested in other users with whom they had relationships, achieving the aim of the link function: enabling users to grasp contexts from many viewpoints. Answers to "For grasping your situation, was the link function useful for reading other people's comics?" included eighteen "usefuls", two "not usefuls", seven "don't knows", and four said they did not notice the function. Except those who did not notice, 67% of the users generally had a positive impression of the function. On the other hand, the problem for users who did not notice the function was apparently caused by the lack of an instruction manual.

7.2. *Comic-FOAF-Viewer service for conference attendees*

Table 1 shows the results for the Comic-FOAF-Viewer. JSAI2004 was held from June 2–5, 2004. The valid period, however, was between the 3rd and the 5th because announcements informing attendees about this service were delayed. At JSAI2004, the organizer provided a web-based supporting system for attendees.[15] One service of the system showed personal networks among conference presenters. FOAF files processed by Comic-FOAF-Viewer were generated from this network.

Table 1. Results of experimental service at an academic conference.

Results	
Total traffic (June 3–5)	280
Average number of clicked link anchors	2.86
Total number of users	135

Comic-FOAF-Viewer was accessed 280 times between June 3 and 5. After concluding the service, we distributed a questionnaire by e-mail; 125 users answered, and 15 replied that they had used the Comic-FOAF-Viewer.

The total traffic analyzed by Apache log was 264, and a total of 135 people viewed the comics. The existence of at least 60 users is assumed based on IP addresses, excluding duplication. Analysis results also indicate that the average path length traveled by users through the comics was 2.86. These results indicate that on average users read more than three comics through the link connecting comic strips, and it seems reasonable to conclude that comic-style representation functioned as an interface as a web-browser anchor. The results also indicate that the Comic-FOAF-Viewer worked as an FOAF browser for such users. However, for 90 users, the path length was zero, i.e., they did not read a single comic, accounting for 67% of the total users, and 30% of those who said, “I did not notice the link function” on their questionnaires. One cause for this is assumed to be that there were no instructions for using the link interface.

8. Conclusion and Future Work

We proposed a technique for generating comic strips representing complex statements with circumstances and context such as experience and a method hyperlinking related comic strips for sharing. For instance, two systems represented individual experiments from ubiquitous environments, personal profiles, and acquaintanceships from FOAF network. However, several issues remain. Both proposed systems only featured frames of identical sizes, whereas conventional comic books usually have a complex frame-size layout to facilitate the flow of understanding and significant story frames. In the future, therefore, we must obtain frame layout grammar and apply it to the rendering step. Reducing the cost of preparing part data for each source data is the next step. We are interested in a computer graphic technique called non-photorealistic rendering. If characters are prepared as 3D models and rendered into cartoon-like images viewed from various angles, illustration costs may be reduced.

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References

1. S. McCloud, *Understanding Comics* (Kitchen Sink Press, 1994).
2. Dan Brickley, Friend of a friend. http://www.foaf-project.org/.
3. D. E. Rumelhart, Notes on a schema for stories, in *Representation and Understanding: Studies in Cognitive Science* (Academic Press, 1975).
4. R. C. Schank and R. P. Abelson, *Scripts, Plans, Goals and Understanding: An Inquiry into Human Knowledge Structures* (L. Erlbaum, 1977).
5. N. Okada and T. Endou, Story generation based on dynamics of the mind, *Computational Intelligence* **8** (1992) 123–160.
6. D. Kurlander, T. Skelly and D. H. Salesin, Comic chat, in *Proceedings of SIGGRAPH96* (ACM Press, 1996), pp. 225–236.
7. S. Uchihashi, J. Foote, A. Girgensohn and J. Boreczky, Video manga: Generating semantically meaningful video summaries, in *Proceedings of ACM Multimedia '99* (ACM Press, 1999), pp. 383–392.
8. J. Boreczky, A. Girgensohn, G. Golovchinsky and S. Uchihashi, An interactive comic book presentation for exploring video, in *CHI '00: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (ACM Press, 2000), pp. 185–192.
9. K. Nagao, Semantic annotation and transcoding: Making web content more accessible, *IEEE MultiMedia* **8**(2) (2001) 69–81.
10. J. Ferraiolo, J. Fujisawa and D. Jackson, Scalable vector graphics (svg) 1.1 specification, http://www.w3.org/TR/SVG11/.
11. Y. Sumi, R. Sakamoto, K. Nakao and K. Mase, Comicdiary: Representing individual experiences in a comics style, in *Ubicomp 2002, LNCS 2498*, eds. G. Borriello and L. E. Holmquist (Springer, 2002), pp. 16–32.
12. R. Sakamoto, K. Nakao, Y. Sumi and K. Mase, Comicdiary: Representing individual experiences in comics style, in *SIGGRAPH 2001 Sketches & Applications* (ACM, 2001), p. 158.
13. Y. Sumi, T. Etani, S. Fels, N. Simonet, K. Kobayashi and K. Mase, C-map: Building a context-aware mobile assistant for exhibition tours, *The First Kyoto Meeting on Social Interaction and Communityware*, June 1998 *(also published in Toru Ishida ed., Community Computing and Support Systems, LNCS 1519*, 1998), pp. 137–154.
14. Y. Sumi and K. Mase, Communityware situated in real-world contexts: Knowledge media augmented by context-aware personal agents, in *The Fifth International Conference and Exhibition on the Practical Application of Intelligent Agents and Multi-Agents (PAAM 2000)*, 2000, pp. 311–326,
15. Y. Matsuo, J. Mori, M. Hamasaki, K. Ishida, T. Nishimura, H. Takeda, K. Hasida and M. Ishizuka, Polyphonet: An advanced social network extraction system, in *Proc. 15th International World Wide Web Conference (WWW2006)*, 2006.