### Estimating Groups of Featured Characters in Comics with Sequence of Characters' Appearance

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## **Problem Setting**

- People cannot search for comics based on the storyline.
  - Storyline is a sequence of information that indicates "how the story is progressing, and in which episode (or page) there is excitement."
- Our Final Goal:

To develop a content-based comic retrieval system with the storyline.

## **Research Question**

### How do we extract the comic elements that characterize the storyline?



Characters
Frames
Lines

"Giga Tokyo Toy Box" (c)Ume

- Characters are one of the most important elements.
- Among characters, there are featured characters who lead a scene semantically.

## **Featured Characters**

- Featured characters are those who lead a scene semantically.
- A featured character is not always one person in a section.



"Dragon Ball" (c)Akira Toriyama

## How to estimate featured characters as a group?

- Featured characters change fluidly in the story.
- Human readers intuitively understand this change for each page turn.
- How can we computationally extract what the reader intuitively grasps?



- Sequences of characters' appearance is one of the tools to represent the characters' activities fluidly.
- We focus on sequences of characters' appearance to estimate a group of featured characters.



## Achievement

# The featured characters can be estimated by using the sequences of characters' appearance.



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## **General Concept**

# **1**Creating the sequences of characters' appearance



# **2**Estimating groups of featured characters



### Step1: Information Represented the Character's Activities

### How the character's activities are represented?



## Step1: Calculating the Characters' Appearance Rate

Count-based appearance Rate Appearance counts

Frame counts



Frame range



- The annotations of the characters and frames are obtained by referring to Manga109.
- The annotation is represented by the smallest rectangular(x<sub>min</sub>, x<sub>max</sub>, y<sub>min</sub>, y<sub>max</sub>) region that covers all the objects.

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### Step1: Creating the Sequences of Characters' Appearance

### **Count-based sequences**



### **Range-based sequences**



## *N*-pages moving average to smooth the sequences









## Experiment

- We evaluated whether the proposed method could estimate featured characters same as human readers.
- We compared the proposed method with the comparison method and considered the effectiveness of the proposed method.



## Subjective Evaluation for Group of Featured Characters

#### **Comics used in comparison experiments**

Title	Author	Number of Characters	Number of Facing Pages
Akkera Kanjincho	Yuki Kobayashi	11	62
Belmondo	Shoei Ishioka	16	90
Hisoka Returns!	Ken Yagami	11	81
Love Hina	Ken Akamatsu	10	87
Dual Justice	Yusuke Takeyama	9	94
Gakuen Noise	Hiroyuki Oshima Daisuke Inohara	13	94
Hinagiku Kenzan	Minene Sakurano	13	85
Touta Mairimasu	Shinji Saiji	14	105
Giga Tokyo Toy Box	Ume	15	99
Tokyo Toy Boxes	Ume	18	92

We prepare five sections randomly set for each comic title. We obtain the participants' subjective evaluation for each section.



## **Estimating Groups of Featured Characters**

### About the sequences we use :

C-10 : Count-based sequences smoothing degree 10 C-20 : Count-based sequences smoothing degree 20 C-30 : Count-based sequences smoothing degree 30

R-10 : Range-based sequences smoothing degree 10
R-20 : Range-based sequences smoothing degree 20
R-30 : Range-based sequences smoothing degree 30

### **Clarify the following points :**

1. Which information do human readers perceive : visual information or semantic information?

2. How much do human readers perceive the characters' activities?



 $FG_{Sr}^{Seq}$ 

## **Comparative Methods**



## **Method of Evaluation**

 Comparing the featured characters estimated by each method and human readers' senses



## Result

	The proposed method						Comparative method	
	C-10	C-20	C-30	R-10	R-20	R-30	Frame	All
Akkera Kanjincho	0.67	0.65	0.65	0.67	0.69	0.68	0.66	0.60
Belmondo	0.65	0.63	0.70	0.67	0.70	0.61	0.64	0.55
Hisoka Returns!	0.85	0.85	0.75	0.81	0.81	0.75	0.84	0.72
Love Hina	0.76	0.87	0.80	0.77	0.80	0.80	0.51	0.34
Dual Justice	0.92	0.96	0.96	0.96	0.96	0.96	0.93	9,75
Gakuen Noise	0.56	0.72	0.78	0.69	0.85	0.89	0.53	0.36
Hina								
<b>Tour</b> Relatively smoother range-based sequences could estimate								.46
Giga the featured characters with human readers' senses.								
Tokyo Toy Boxes	0.57	0.92	0.93	0.76	0.93	0.93	0.85	0.36
Average of $\overline{\mathbf{F}^{M}}$	0.70	0.79	0.80	0.76	0.82	0.81	0.67	0.48

## **Point of Discussion**

• Using the sequences of Range-based appearance could estimate featured characters.

Readers evaluate the activities based on visually represented appearances.

• "All" couldn't estimate the featured characters evaluated by human readers.

Human readers were likely to classify the characters as featured or not featured during sections.

 "Frame" couldn't estimate the featured characters evaluated by human readers. Why was "Big-Frame" insufficient as a factor for estimating the featured characters?

## Discussion

Why did "Frame" fail to estimate the featured characters by human readers?



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- Big-Frame sometimes showed a group image of characters without consideration of featured characters.
- Some of characters in Big-Frame were actively featured in a story described in the before and after, while others were not.
- It let us consider that **Big-Frame itself was** insufficient to estimate the featured characters.

## Conclusion

- We have proposed a method to estimate a group of featured characters by using the sequences of characters' appearance.
- From the comparison results, smoother range-based sequences could estimate the featured characters with human readers' senses.
- Furthermore, it has been suggested that human readers had evaluated the characters' activities based on the range of characters' appearance.

## **Future Work①:Studying Scene Segments**



- Extracting the featured characters for each scene makes it possible to extract the timing of featured character changes.
- The timing of character changes may be the scene segment that readers understand unconsciously.
- In our future work, we will study scene segments based on the findings of this research.

## Future Work2:Creating Appearance Sequence of Featured characters



Extracting the MCL



- By calculating the average appearance rate of the featured characters for each page, we can extract the sequence of appearance rate concerning the role of the featured character(Main Chara Line : MCL).
  - MCL is compared to music research :
    - Storyline → Musical piece
    - Characters → Instruments
    - Appearance sequence of each character
    - → Melody of each instrument
    - MCL→Main melody of a musical piece

MCL can be considered as the main element of storyline.