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Recognition of very low-resolution characters from motion images captured by a portable digital camera

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Abstract Many kinds of digital devices can easily take motion images such as digital video cameras or camera-equipped cellular phones. If an image is taken with such devices under everyday situations, the resolution is not always high; moreover, hand vibration can cause blurring, making accurate recognition of characters from such poor images difficult. This paper presents a new character recognition algorithm for very low-resolution video data. The proposed method uses multi-frame images to integrate information from each image based on a subspace method. Experimental results using a DV camera and a phone camera show that our method improves recognition accuracy.

Keyword Character recognition Subspace method Low resolution Motion images

1.

DV

URL

[1] [8]

1

[2]

[3]

[4]

[8]

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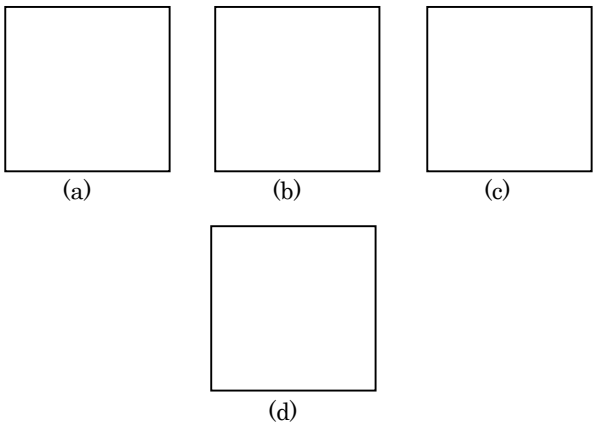
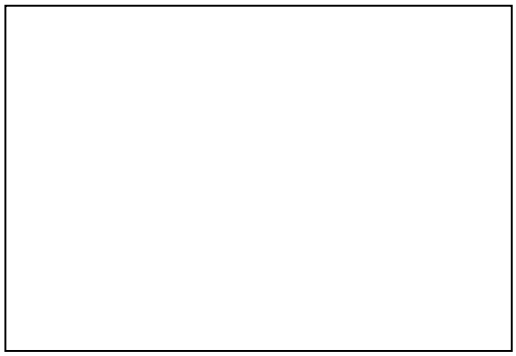


1 ‘A’ a , b , c DV d



2

2

3 4

5

2.

2.1

1

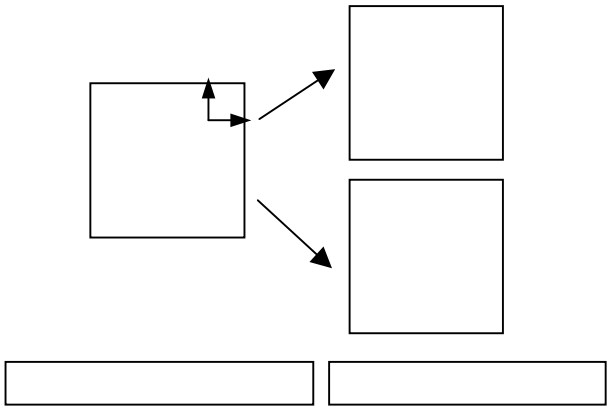
1 (a),(b),(c) DV

(d)

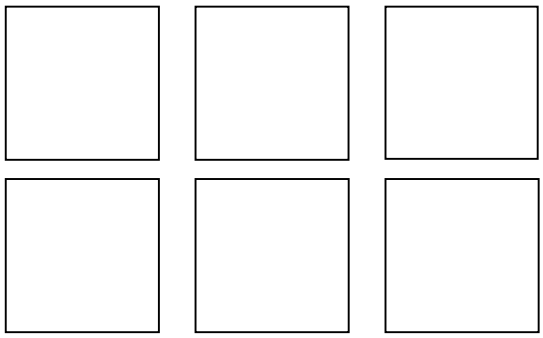
2 1 (c) (d)

2.2

DV



3



4 “A”

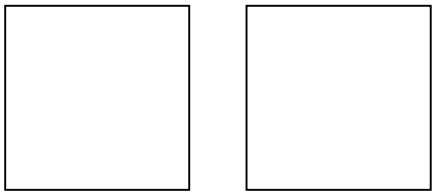
3 DV “A”

2

3.

3

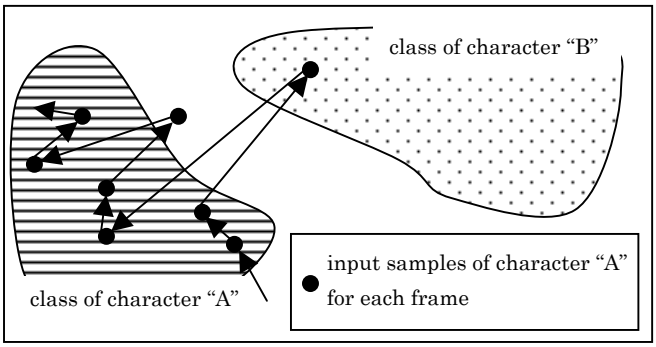
3.1



5 “A”

1 2

-
-
- 1 6 × 6 pixel



6

3.3

4

$$\{\boldsymbol{a}_1, \boldsymbol{a}_2, \cdots, \boldsymbol{a}_M\}$$

$\boldsymbol{a}_m$ M

c

$$L^{(c)}(\boldsymbol{a}) = \frac{1}{M}\sum_{m=1}^{M}\sum_{r=1}^{R}(\boldsymbol{a}_m, \boldsymbol{e}_r^{(c)})^2$$

$(\boldsymbol{x}, \boldsymbol{y})$

3.2

i

0

6

$$\boldsymbol{x}_i = [x_1, x_2, \cdots, x_N]^T$$

N

k

$$\boldsymbol{X} = [\boldsymbol{x}_1, \boldsymbol{x}_2, \cdots, \boldsymbol{x}_k]$$

$$\boldsymbol{Q} = \boldsymbol{X}\boldsymbol{X}^T$$

$\boldsymbol{Q}$

R

c

$$\{\boldsymbol{e}_1^{(c)}, \boldsymbol{e}_2^{(c)}, \cdots, \boldsymbol{e}_R^{(c)}\}$$

5

4.

DV

Century

62

7

A	B	C	D	E	F	G	H	I	J	K	L	M
N	O	P	Q	R	S	T	U	V	W	X	Y	Z
a	b	c	d	e	f	g	h	i	j	k	l	m
n	o	p	q	r	s	t	u	v	w	x	y	z
0	1	2	3	4	5	6	7	8	9			

7 Century

32 × 32 pixel

- DV
- 70cm
- (**size1** 16 × 16 **size2** 11 × 11 **size3** 8 × 8 **size4** 7 × 7 **size5** 6 × 6 pixel)
- 10 50

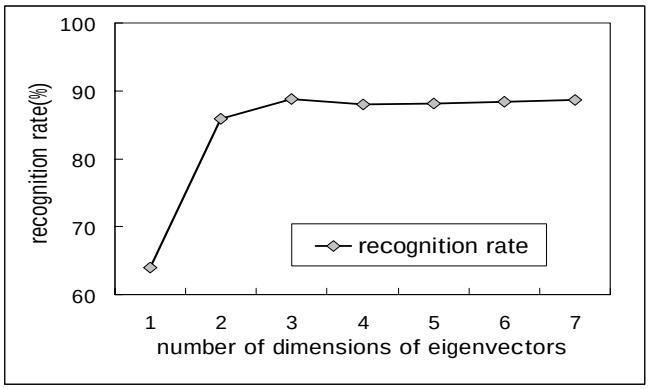
- DV
-
-
  - **size5** 70cm 6 × 6 pixel
- 20
- 32 × 32 pixel
- 30

8

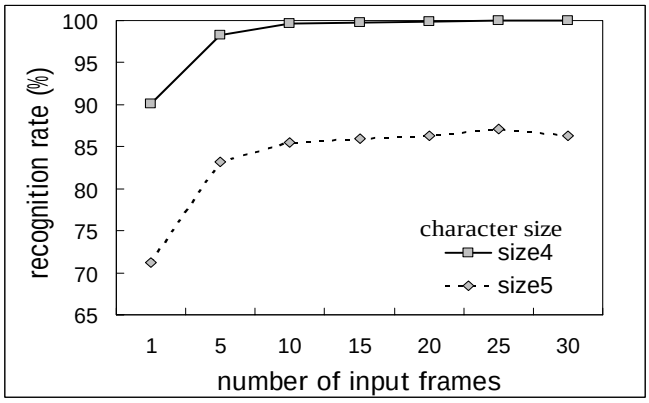
3

5

4.1



8



9 **size3**

100%

- 5

- DV
-
-
  - **size4** 60cm 7 × 7 pixel
  - **size5** 70cm 6 × 6 pixel
- 32 × 32 pixel
- 30

4.1.1. vs.

9

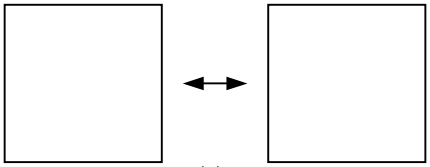
15

7 × 7 pixel 100%

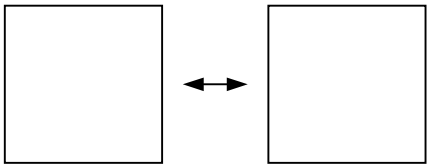
1 size5

20 30

			%
S	s	30	0
V	v	30	0
Z	z	30	0
l	1	30	0
0	o	30	0
8	s	30	0
I	1	23	23
	I	7	
X	x	22	26
	X	8	



(1)



(2)

10

1 “V” “v” 2 “l” “1”

size3

100%

4.1.2.

1 6×6 pixel

20

“V” “S”

10 1

“l” “8”

2 7×7 pixel DV

	( )
DV	99.9
	94.4

10 2

4.2

DV

DV

- CCD 31
- 162×220 pixel
- 7.5 fps

- 20 cm
- 7×7 pixel
- 32×32 pixel
- 20
- 30

2 DV

DV

DV

一タ

3
size5 ）.

	(%)
	86.3
	82.6
	86.4

4.3

DV
〃 〃
4.1

- size5
- 〃 〃 〃 〃 〃 3
- 20
- 30

3

0

5.

1

DV

21 COE
No.16300054

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