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The Recognition of a Human Arm Gesture for a Game Interface

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HMM(Hidden Markov Model)
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1.   .

(Dynamic Time Warping, DTW)   ,
(HMM)   (Conditional
Random Field, CRF)   [3-5].

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,
[1].   HMM   .
/   10
1   .
10   . 2
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, 4
.   .   5
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2.

2.1 HMM(Hidden Markov Model)

3   HMM   1960   1970   Baum
.   Microsoft   Kinect
RGB,   ,   .
.   HMM
,   ,
, DNA
[2].   . HMM

[6].

Notation: $\lambda = (A, B, \Pi)$ (1)

N = Number of States   (2)

M = Number of symbols observable in States

$V = \{ v_1, \cdots, v_m \}$ (3)

A = State transition probability distribution

$A = \{a_{ij}\}, \quad 1 \le i, j \le N$ (4)

B = Observation symbol probability distribution

$B = \{b_i(v_k)\}, \quad 1 \le i \le N, 1 \le k \le M$ (5)

$\tilde{O}$ *= Initial State distribution*

$\pi_i = p(q_1 = i), \quad 1 \le i \le N$ (6)

HMM

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HMM

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A, B, $\tilde{O}$,   ,

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$A = |a_{ij}|$

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$a_{ij} = P(q_{t+1} = s_j \,|\, q_t = s_j), \quad 1 \le i, j \le N$

$\sum_{j=1}^{n} a_{ij} = 1$ (7)

$B = |b_j(v_k)|$

.

$b_j = P(O_t = v_k \,|\, q_t = s_j), \quad 1 \le j \le N, 1 \le k \le M$

$\sum_{k=1}^{m} b_j(v_k) = 1$ (8)

$\Pi = |\pi_i|$

.

$\pi_i = P(q_1 = s_i, \quad 1 \le i \le N$

$\sum_{i=1}^{n} \pi_i = 1$ (9)

HMM   .

2.2 Kinect

Kinect

Fig 1   3

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20   ,

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Kinect

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Kinect   NUI   Kinect
Programming   .
Kinect   ,   ,

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Fig 1. Human Skeleton

3.

Fig 2

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HMM

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```
Preprocessing ( )
{
    Sensing the Position of Joint by Sensor
    Conversion position to vector of direction
}

Learning ( )
{
    Preprocessing ( )
    For each gesture
            Make model using the HMM
}

Recognizing ( )
{
    Preprocessing ( )
    For each model
            Calculate probability
    Select gesture using Winner takes all strategy
}
```
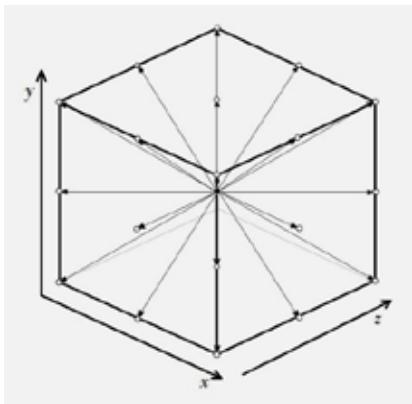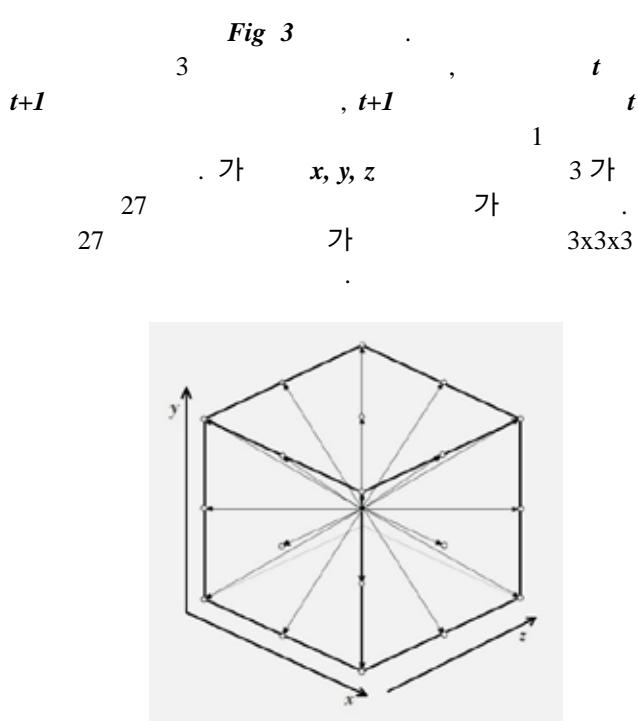
Fig 2. System Process

Fig 3 .

3 , *t*

t+1 , *t+1* *t*

1

. *x, y, z* 3

27 .

27 3x3x3

.

Fig 3. Understandable Direction

4.

4.1

Windows C/C++

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Microsoft Kinect , SDK 1.7 .

10 10

. *Fig 4* 10

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No.	Gesture	No.	Gesture
A		F	
B		G	
C		H	
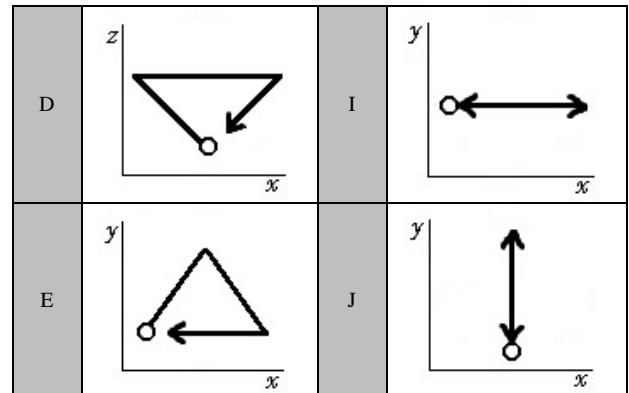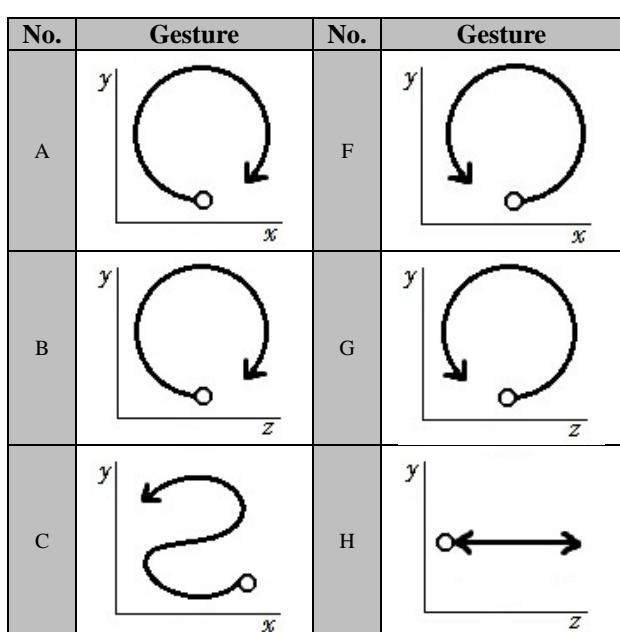
Fig 4. Sign Language Motion

100 50%

HMM ,

50% .

Fig 5 A

. A

E E A

False Negative . *Fig 5*

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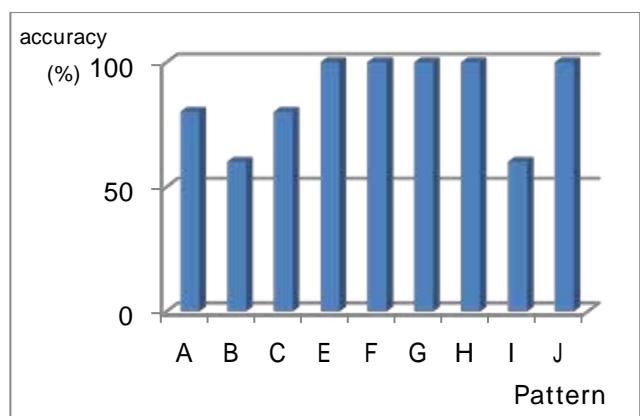
Fig 5. Average accuracy rate (%)

88% ,

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Table 1

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Table 1. Account for error (%)

Pattern	Selected	Rate
A	E	20%
B	G	40%
C	F	20%
I	D	20%
I	C	20%

Table 1   Pattern   , Selected
.   A
80%   ,   20%   E
.   I   40%   D
C   20%   .

5.

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HMM
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[1]   , "
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8   9   (2005).
[2]   , "
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39   10   , (2012.10)
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