The Sign2 Project

Digital Translation of American Sign-Language to Audio and Text
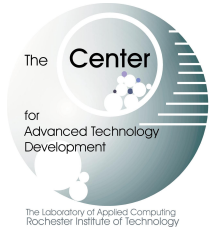
The Center
for
Advanced Technology
Development

The Laboratory of Applied Computing
Rochester Institute of Technology

Fitzroy Lawrence, Jr.

Advisor: Dr. Chance Glenn,

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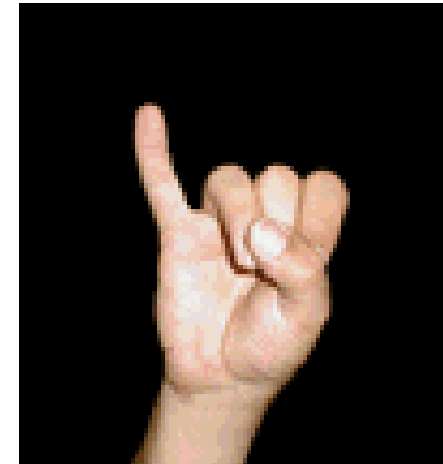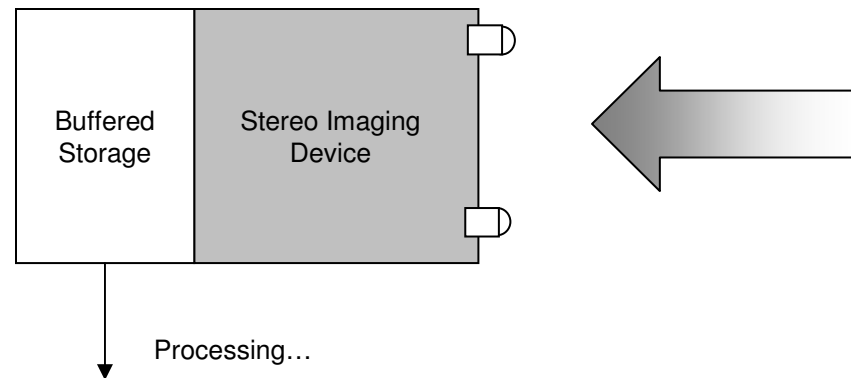Rochester Institute of Technology

The purpose of my research is to implement a device or apparatus that captures American Sign Language and converts it into sound and/or text. This will enable people who cannot use sign language to communicate with deaf and hard of hearing people.

The way I plan to achieve these results are through the means of image processing. Using a combined method developed within Rochester Institute of Technology and Binghamton University, we are using a set of default "points" set all over the left and right hands (Points-of-Digital Articulation) to extract and compute into a database different letters of the American Sign Language. This will be expanded on with more body movements later on.

By maximizing, the results I wish to obtain will lead to the production of a portable device that can be worn or carried by a deaf or hearing impaired individual that can translate American Sign Language into English text or sound, in real-time, in a efficient manner
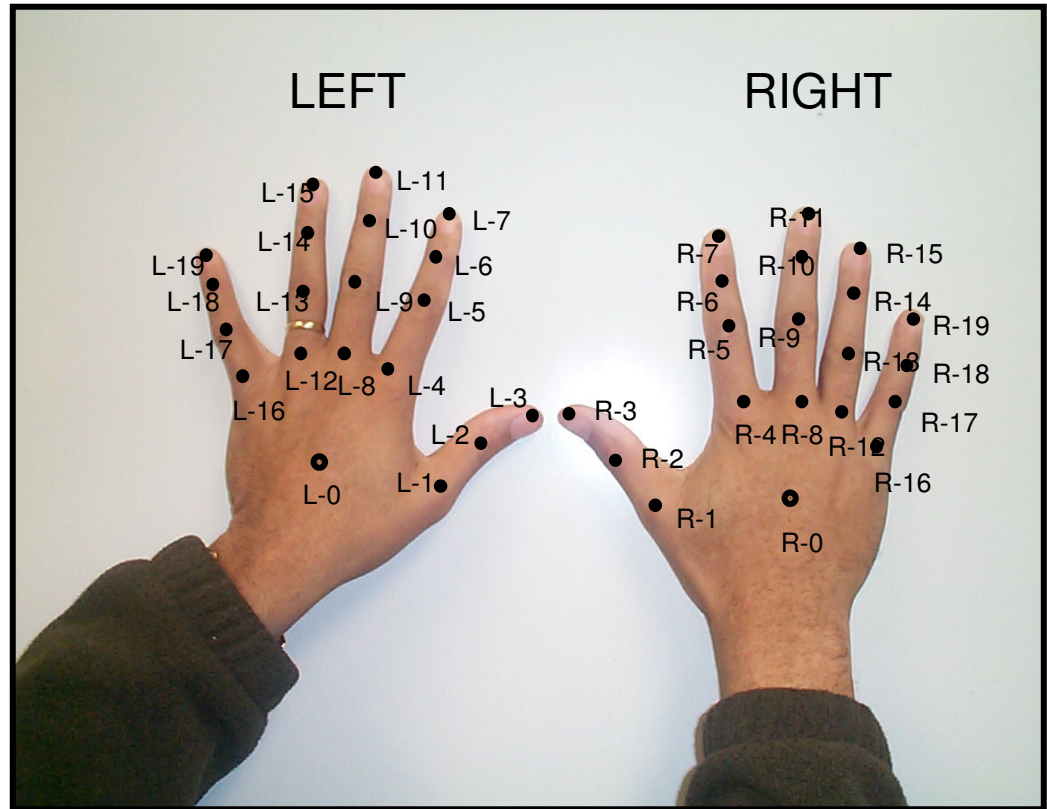
Project Statement

"The purpose of my research is to implement a device or apparatus that captures American Sign Language and converts it into sound and/or text. This will enable people who cannot use sign language to communicate with deaf and hard of hearing people."
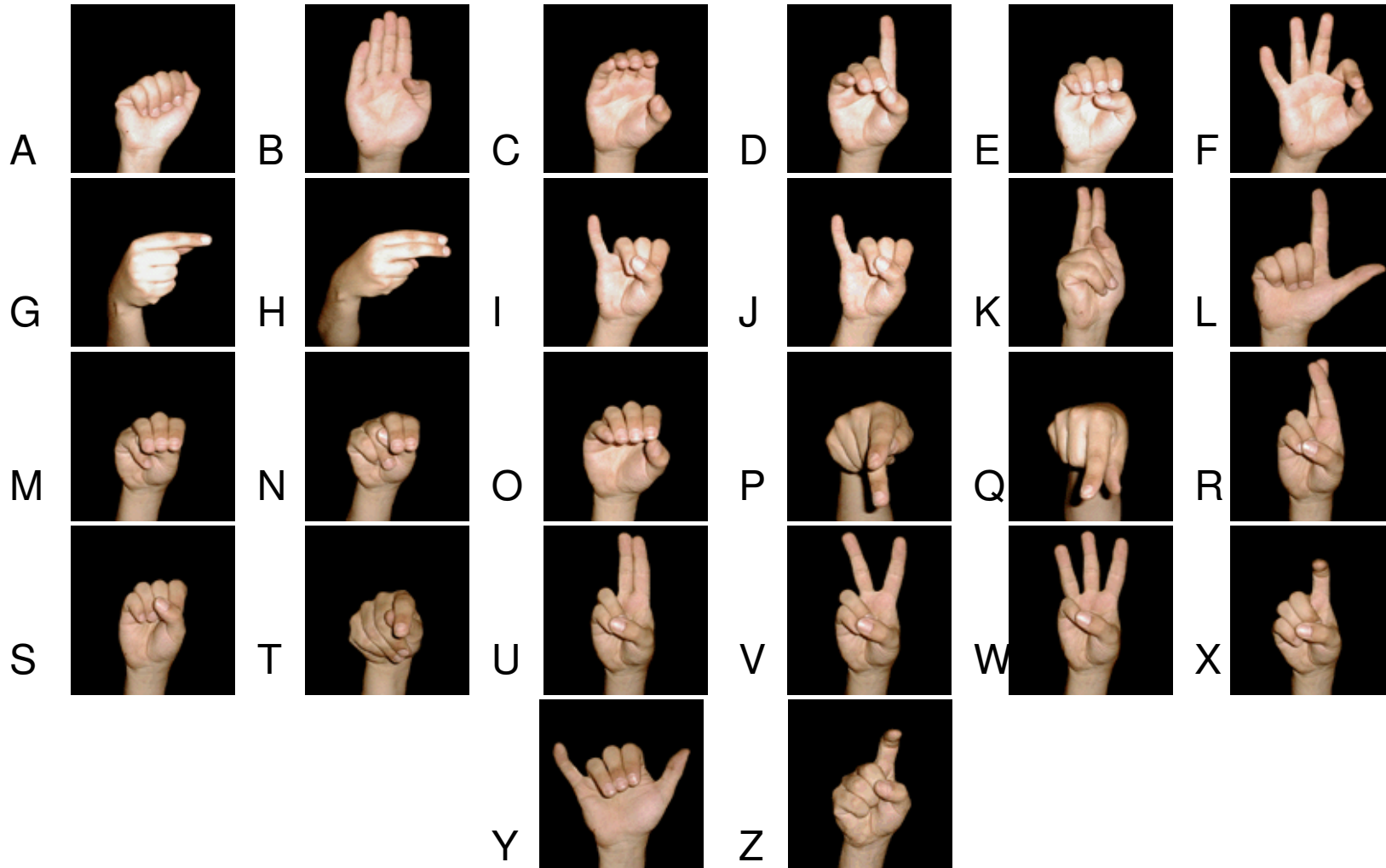

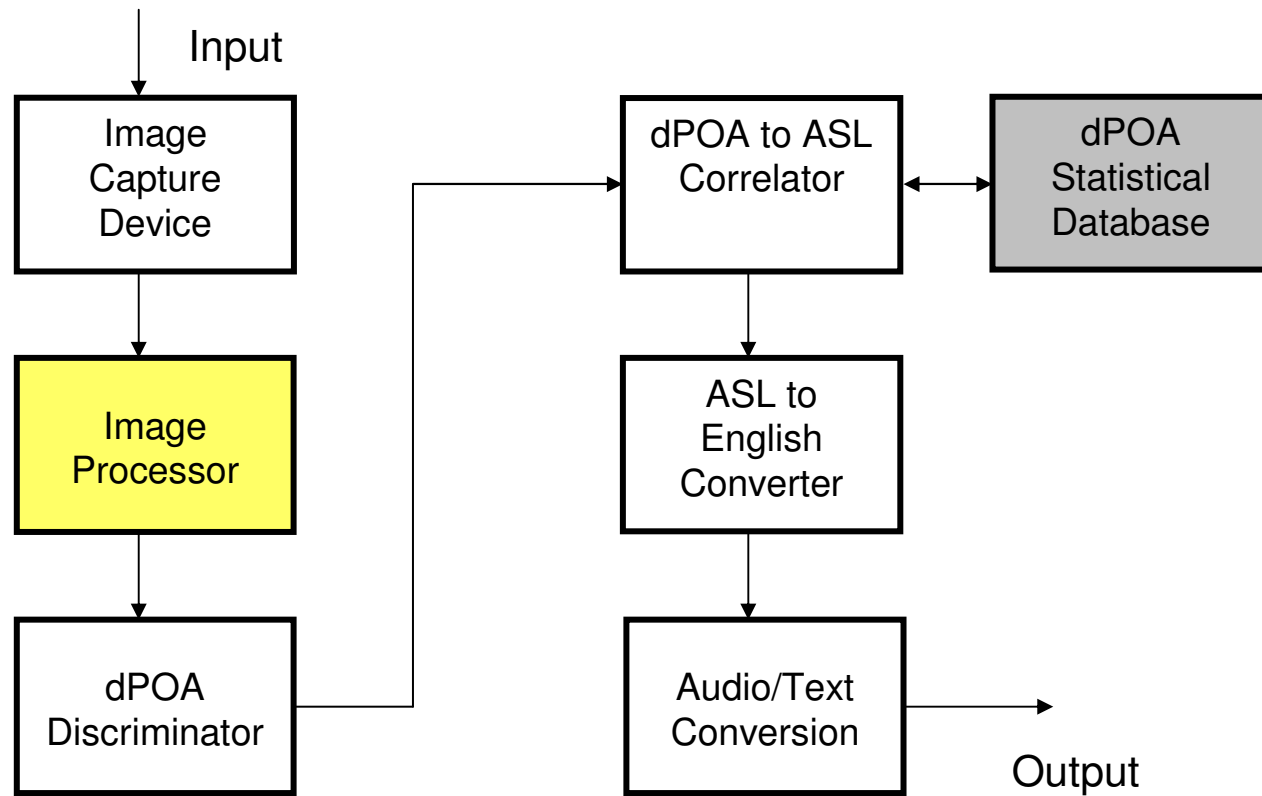| Buffered Storage	Stereo Imaging Device

Processing…

"Hello, how are you?"

•The approach employs the use of advanced image processing.

•Using a combined method developed within Rochester Institute of Technology and Binghamton University, we establish *digital points of articulation* (dPOAs) to extract critical data from the image.

•We will demonstrate this in ASL fingerspelling. This will be expanded on with more body movements later on.
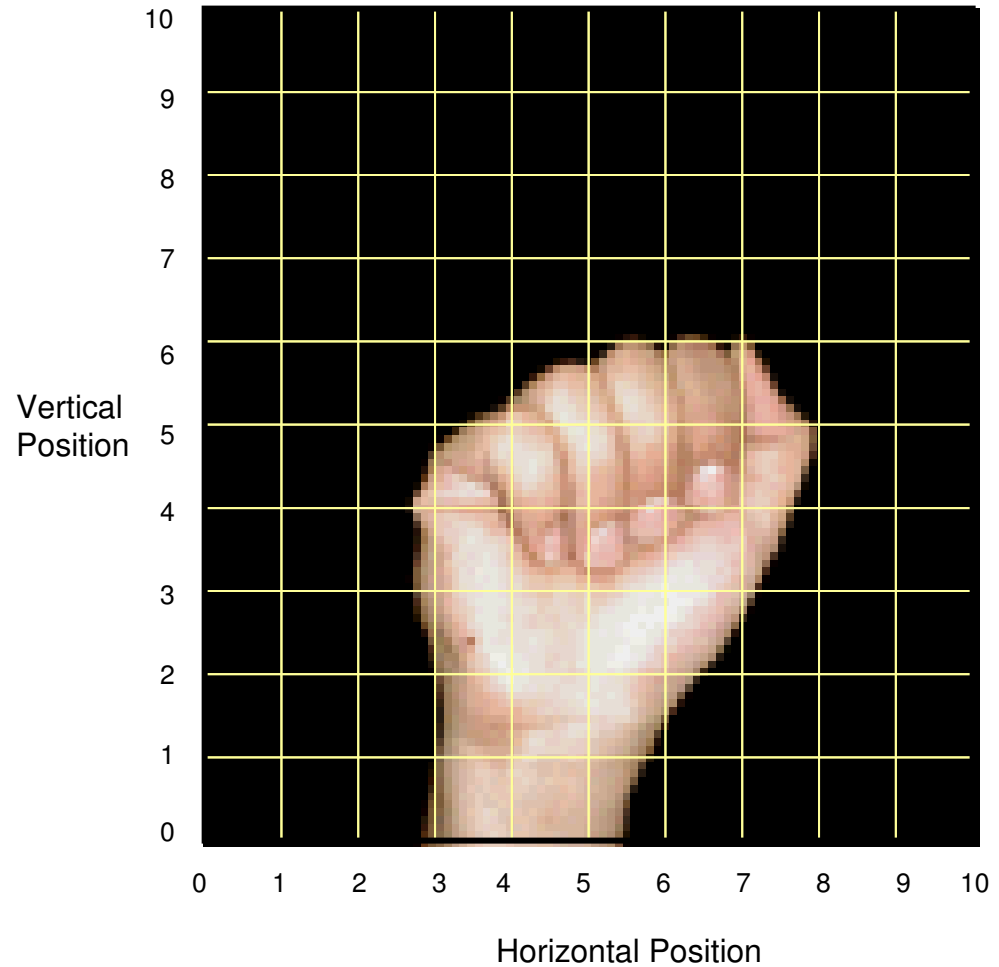
American Sign Language Alphabet

Sign2 System Block Diagram

Input

```
Image Capture Device
        ↓
Image Processor
        ↓
dPOA Discriminator ──→ dPOA to ASL Correlator ←──→ dPOA Statistical Database
                              ↓
                       ASL to English Converter
                              ↓
                       Audio/Text Conversion ──→ Output
```

.

Letter: A

| POAr Indicator	H-Position	V-Position
R-0	5.5	4
R-1	7.5	3.5
R-2	7.9	5
R-3	7	6
R-4		
R-5	6.5	6
R-6	6	8.1
R-7	6	9.2
R-8		
R-9	5.5	6
R-10	5.7	5
R-11	5.7	3.7
R-12		
R-13	4.5	5.7
R-14	5	4.5
R-15	5.2	3.2
R-16	3	4
R-17	4	5.2
R-18	4.5	4.5
R-19	4.5	3.5

Vertical Position

Horizontal Position

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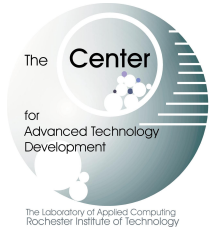
Letter: A (2nd Trial)

POAr Indicator	H-Position	V-Position
R-0	5	4
R-1	7.5	3.5
R-2	7.5	5.5
R-3	6.5	6.5
R-4		
R-5	6	6.2
R-6	6	5
R-7	6	4.5
R-8		
R-9	5	6
R-10	5	4.5
R-11	5	4.2
R-12		
R-13	4	6
R-14	4.5	5
R-15	4.5	4.2
R-16	3	4
R-17	3.5	5.5
R-18	4.2	3.5
R-19	4	4

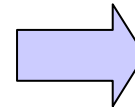Vertical Position

Horizontal Position
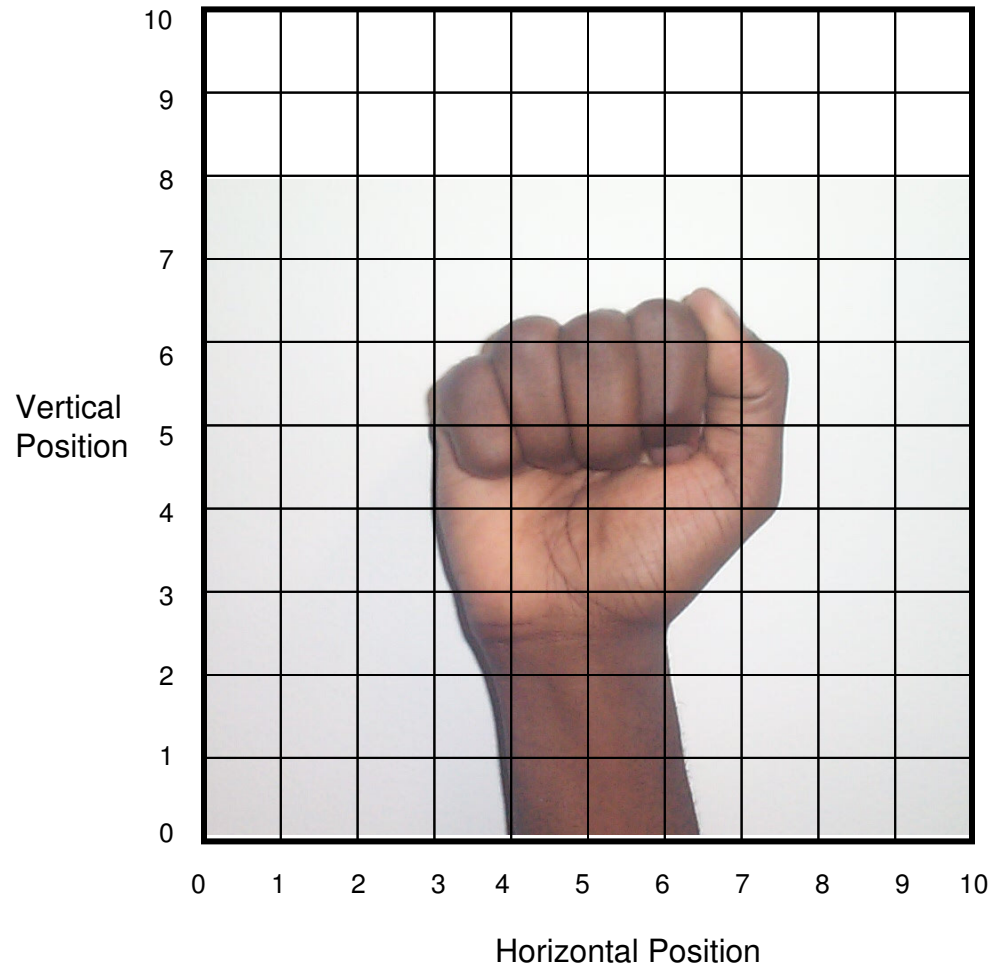
After Imagine Capturing…

RIGHT	A	
POAr	x	y
0	5.5	4
1	7.5	3.5
2	7.9	5
3	7	6
4		
5	6.5	6
6	6	8.1
7	6	9.2
8		
9	5.5	6
10	5.7	5
11	5.7	3.7
12		
13	4.5	5.7
14	5	4.5
15	5.2	3.2
16	3	4
17	4	5.2
18	4.5	4.5
19	4.5	3.5

scaling & positioning →
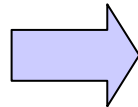
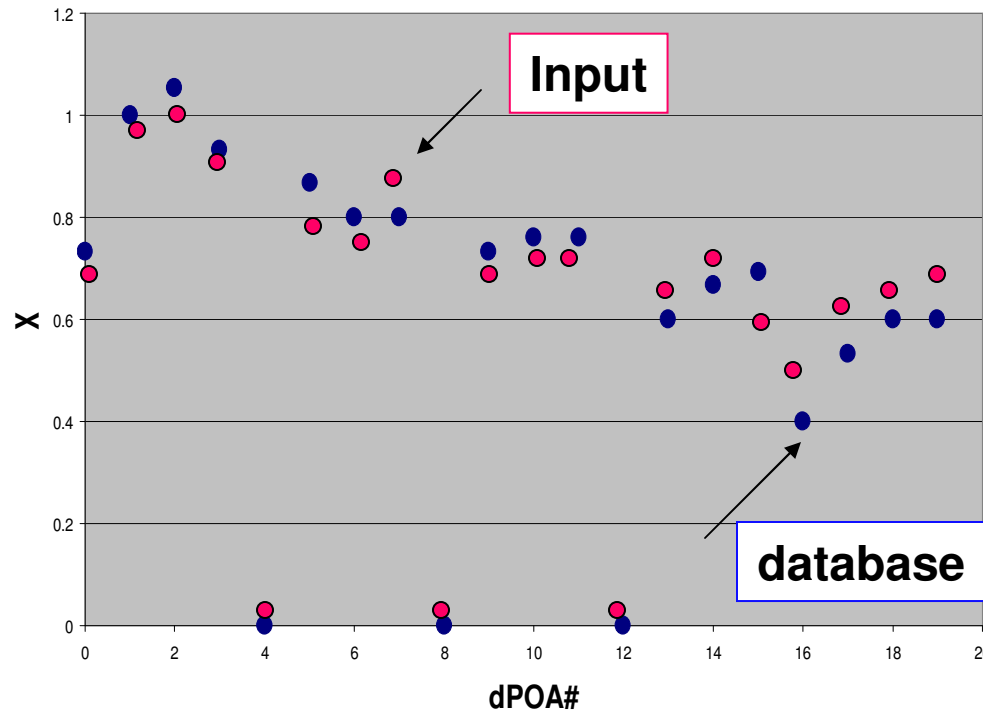| x-scaled	y-scaled
0	0
2.5	0
2.5	1.5
1	1.5
-5	-4
1	3
1	4
1	5
-5	-4
0	3
0	4.2
0	5.5
-5	-4
-0.8	3
-0.5	4
-0.5	5
-2	0.5
-1.5	2
-1.5	3
-1.3	3.8

normalization →

x-norm	y-norm
0.666667	0.421053
1	0.421053
1	0.578947
0.8	0.578947
0	0
0.8	0.736842
0.8	0.842105
0.8	0.947368
0	0
0.666667	0.736842
0.666667	0.863158
0.666667	1
0	0
0.56	0.736842
0.6	0.842105
0.6	0.947368
0.4	0.473684
0.466667	0.631579
0.466667	0.736842
0.493333	0.821053

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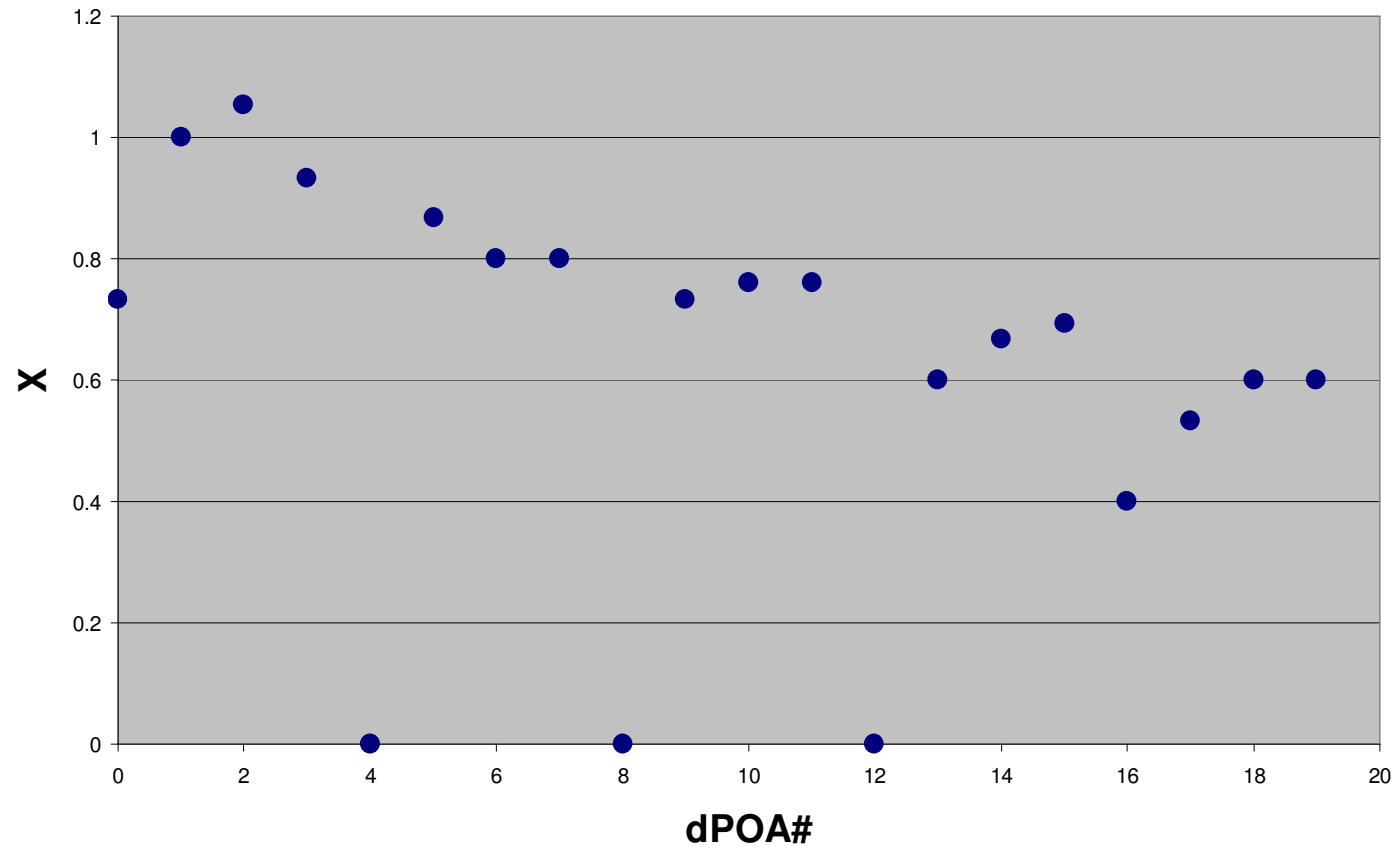# Error Correllation

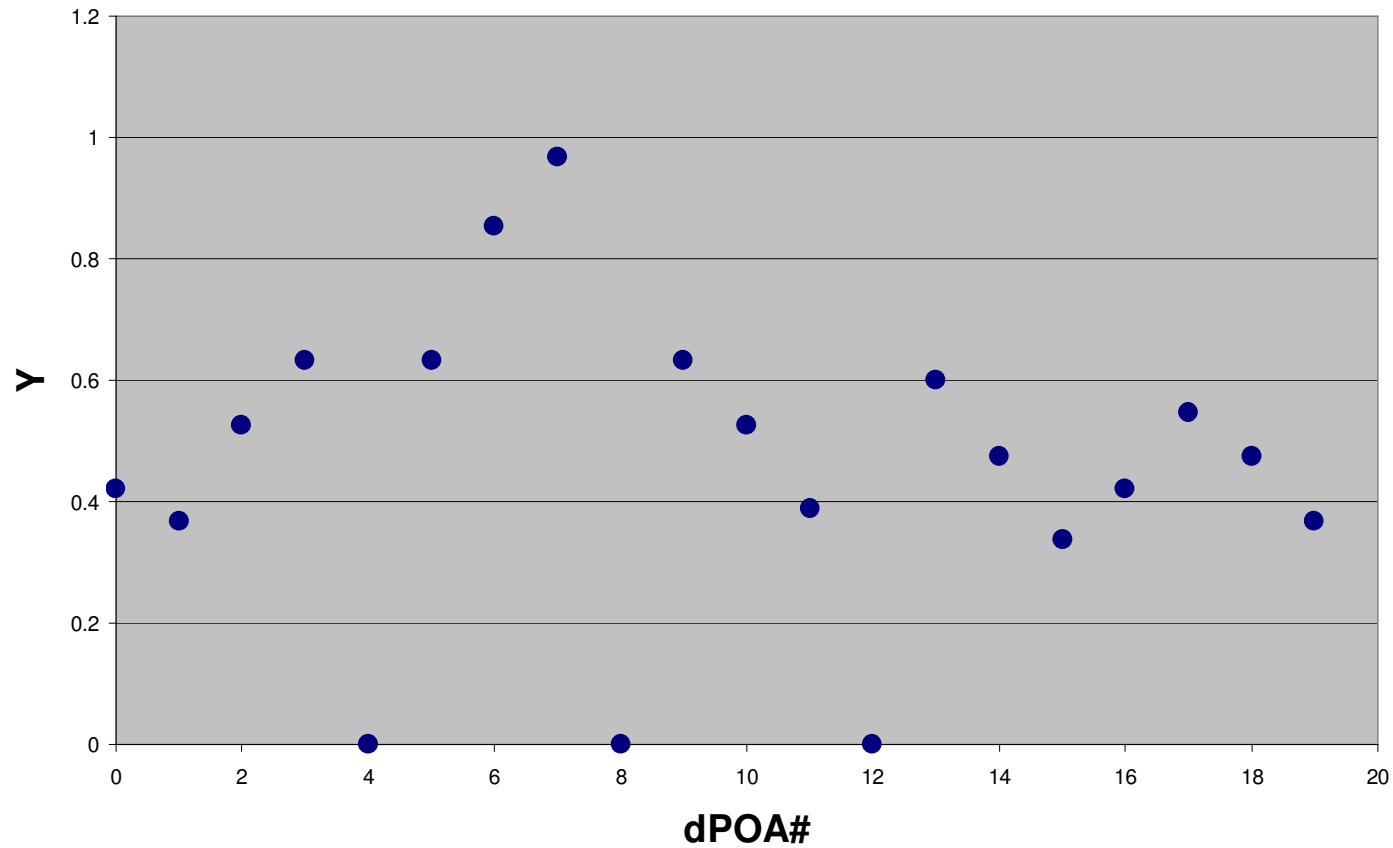**X-Normalized vs. dPOA#**

$$e_n = \left| d_n^B - d_n^I \right|$$

$$e_T = \sum_{n=1}^{19} e_n$$

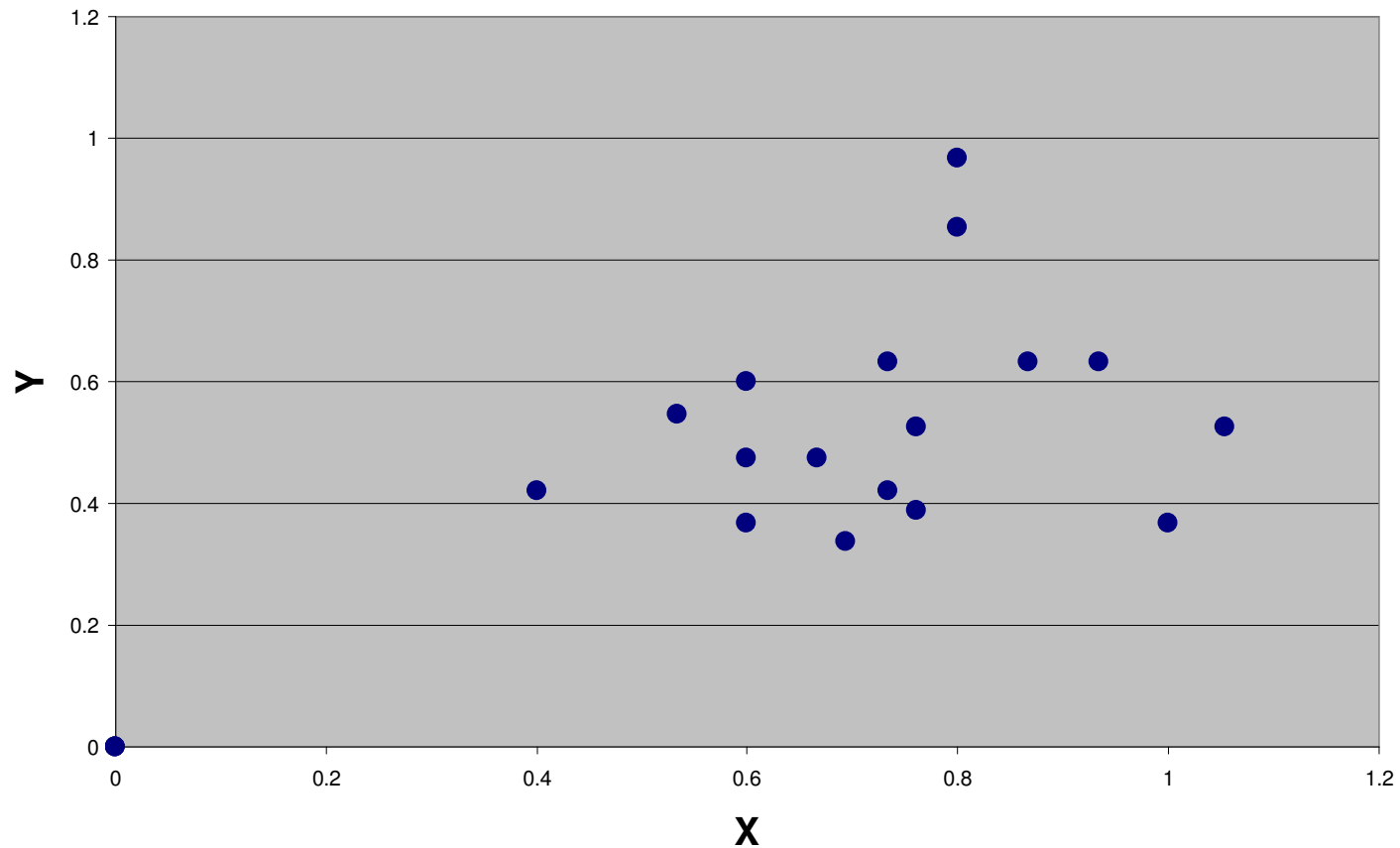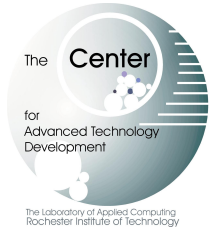Where e_T is minimized, there suggest a match with a pre-stored letter from the statistical database.

Data Processing

X-Normalized vs. dPOA#

Data Processing

Y-Normalized vs. dPOA#

Y-Normalized vs. X-Normalized

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Through these results, I wish to lead the production of a portable device that can be worn or carried by a deaf or hearing impaired individual that can translate American Sign Language into English text or sound, in real-time, in a efficient manner. This device may be worn around the neck, or even placed on the hip.

The realization of this device would allow a person who does not know sign-language to communicate with a deaf person.

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