Animal Sign language recognition using MEMS

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Abstract :
Mple dog's express their feelings by oscillating his tail. Similarly cows express their feelings with his feet, neck and tail. Every feeling has its distinct body movements. So by placing this model on their communicating body part we transform the animal feelings into words and phrases. This model also helps the deaf and dumb community to communicate with others in oral langage. Prototype of sign language recognition consists of ADXL335 accelerometer interfaced with PIC micro controller 16F873A. The interfacing program is written in embedded 'C' language and it is compiled with Hi-tech compiler. The accelerometer data is processed in PC using neural network pattern recognition tool available in MATLAB.

In this model we transformed six American Sign Language postures into words. We proposed two algorithms based on Euclidean distance metric and neural network pattern recognition tool with spline interpolation technique achieving an overall l efficiency of 80% and 83.3% respectively. Former algorithm is preferred because here we achieve an efficiency varying from 70% to 90% where as in Euclidean distance algorithm efficiency varies from 0% to 100%

Keywords-ASL, Euclidean distance, nprtool, MEMS accelerometer, animal sign language, spline interpolation, interpolation technique

I. Introduction

Animals cannot communicate orally with human beings. Even they make different sounds which everyone is not understandable. Every animal express its feelings in their mere way. By seeing the body language we are able to interpret the feelings of that corresponding animal. Every animal has its own distinct movements. So we have to reprogram for each animal. However the model remains same for every animal. Here we are fixing this setup to the dominant body part where animals express their feelings for example say tail, neck, head etc. by tracing this movements we are interpreting their emotions. By doing this we can build the gap between humans and animals and animals can communicate with oral language. We in this paper intended to develop a sign language interpreter which is ideally designed for animals.

The legal recognition of sign languages is one of the major concerns of the international Deaf community. There is no standard way in which such recognition can be formally or legally extended; every country has its own interpretation. In some countries, the national sign language is an official state language, whereas in others it has a protected status in certain areas such as education. However, symbolic recognition is no guarantee for an effective improvement of the life of sign language users. This model is also useful for deaf and dumb community, with this model they can communicate with outside orally.

"Figure1: Sign language interpreter used in CONGO film"

1.1 Source

The intention of this paper is to duplicate a system what is used in the CONGO film to convert 'AMMY' (a talking gorilla) hand movements into oral language as shown in the figure1. It's a science fiction movie. They made a set up and tied to arm of gorilla which is trained with sign language. If gorilla wants to communicate with his trainer it will make the signs with his hand, this setup will convert the signs into words and phrases. By duplicating this model we can use the same concept for other animals.

1.2Posters of some of the words used in this paper

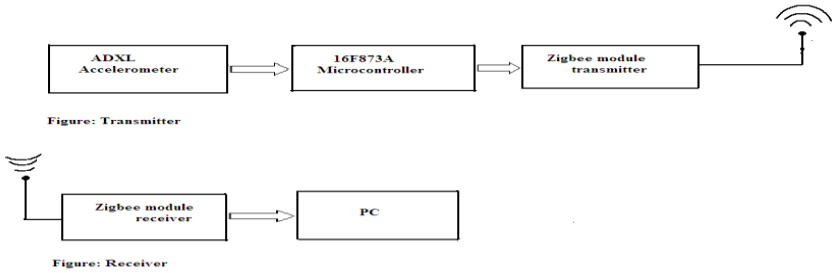
Good **Hello** **Goodbye** **Please** **Thanqu** **Hello**

"Figure2: posters of words corresponding to American sign language(ASL)"

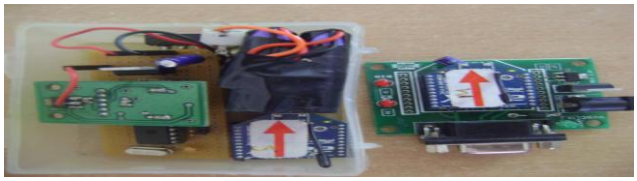
These are the posters of some of the words which we transformed into voice. These posters are belonged to ASL.

"II. Implementation"

Implementation of this model consists of two stages as shown in figure2. First stage consists of transmitting stage where accelerometer sensor ADXL335 is interfaced with PIC 16f873a and the output of microcontroller send to PC via zigbee module



"Figure3: Block Diagram implementation of model"



"Figure 4: Experimental Setup"

Adxl335, PIC, zigbee along with battery is assembled in a box as shown in figure4 and the box is tied to the wrist. This set up will trace the motion of the hand in 3-dimensional i.e., in X,Y and Z-axis. Each sample from the sensor consists of X,Yand Z values.

"III. Design Issues"

To achieve the results to maximum efficiency we have to concentrate on parameters which affect the performance of the model. All the design issues and remedies are discussed below.

3.1Hand movements

1. We should practice every single moment with precise angular velocity.

2. Palm position and orientation

These two parameters are key in practicing hand movements. We have to practice the movements to the movements which is programmed in the system. Any change in above parameters will affect the recognizing rate of the model.

3.2Number of samples

Number of samples considered for computation is key issue because we are translating the signs which have large and small hand displacements, we have to consider more number of samples for large hand displacements and we have to consider less number of samples for small hand displacements for efficient mapping. In this model we considered five samples for computation.

"IV. Results"

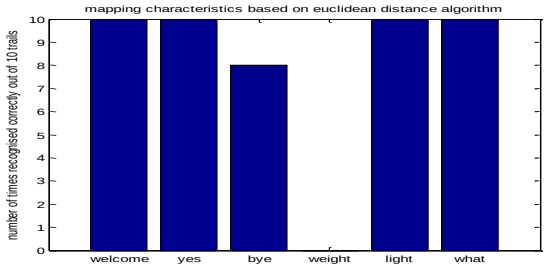
We proposed and worked three algorithms for the model and achieved different recognizing rates for each model. In this model we transformed signs of six words corresponding to American Sign Language into words. The words used in this model are YES, BYE, WELCOME, WEIGHT, LIGHT and WHAT. In each algorithm by practicing sixty trails i.e., ten trails for each word we took the statistics of how many times it recognized correctly and same is plotted in bar graphs taking words on X-axis and recognizing rate on Y-axis, recognizing rates for each word is discussed individually.

4.1 Efficiency of Euclidean distance algorithm

Table 1 reveals the statistics of the word recognition using Euclidian distance algorithm. The same is plotted as bar graph as shown in figure5, Marking words on X-axis and recognizing rate on Y-axis. In this algorithm we achieved an overall efficiency of eighty percent..

"Table1: mapping table"

	Yes	bye	welcome	weight	Light	what
Yes	**10**	**0**	**0**	**0**	**0**	**0**
Bye	**2**	**8**	**0**	**0**	**0**	**0**
Welcome	**0**	**0**	**10**	**0**	**0**	**0**
Weight	**6**	**0**	**0**	**0**	**4**	**0**
Light	**0**	**0**	**0**	**0**	**10**	**0**
What	**0**	**0**	**0**	**0**	**0**	**10**



"Table1: mapping table"

"figure5: recognition rate of each word"

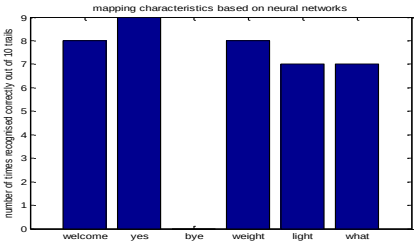
From figure5 and table 1, we reveal that four words i.e., WELCOME, YES, LIGHT, WHAT achieved 100% recognition. The word BYE achieved 80% recognition. The word WEIGHT is not at all recognized achieving 0% efficiency. Out of sixty trails forty eight times the words are recognized correctly yielding overall efficiency 80%.To improvise the recognizing rates we proposed another algorithm which is based on neural networks

4.2 Efficiency of algorithm based on neural network pattern recognition

Table 2 reveals the statistics of the word recognition using npr tool. The same is plotted as bar graph as shown in figure6, Marking words on X-axis and recognizing rate on Y-axis. In this algorithm we achieved an overall efficiency of sixty five percent. In this algorithm we considered five samples from the sensor for computation and filed the recognizing rate of each word yielding least recognizing rate. we tried for other signs corresponding to American sign language resulted almost same recognizing rate and one word is not completely recognizable.

	Welcome	Yes	Bye	weight	light	what
Welcome	**8**	0	0	0	1	1
Yes	0	**9**	0	0	0	1
Bye	1	2	**0**	5	0	1
Weight	0	1	0	**8**	0	1
Light	3	0	0	0	**7**	0
What	1	0	0	2	1	**7**

"Table2: mapping table"



"figure6: recognition rate of each word"

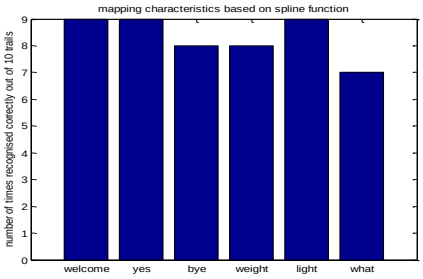
From table 2 and from figure6 we reveal that the word YES has maximally recognized nine times and the words WELCOME, WEIGHT and LIGHT, WHAT have recognized eight and seven times out of ten trails respectively. The word BYE has least recognizing rate of zero percent. In this algorithm thirty nine times out of sixty trails recognized correctly yielding a overall efficiency of sixty five percent.

To improve efficiency further SPLINE interpolation technique is employed to neural network algorithm and better recognizing rates are achieved.

4.3 Algorithm based on npr using SPLINE interpolation technique

	Yes	bye	welcome	weight	Light	what
Yes	**9**	0	0	1	0	0
Bye	1	**8**	1	0	0	0
Welcome	0	0	**9**	0	1	0
Weight	0	0	2	**8**	0	0
Light	0	0	0	0	**9**	1
What	0	3	0	0	0	**7**

"Table3: mapping table"

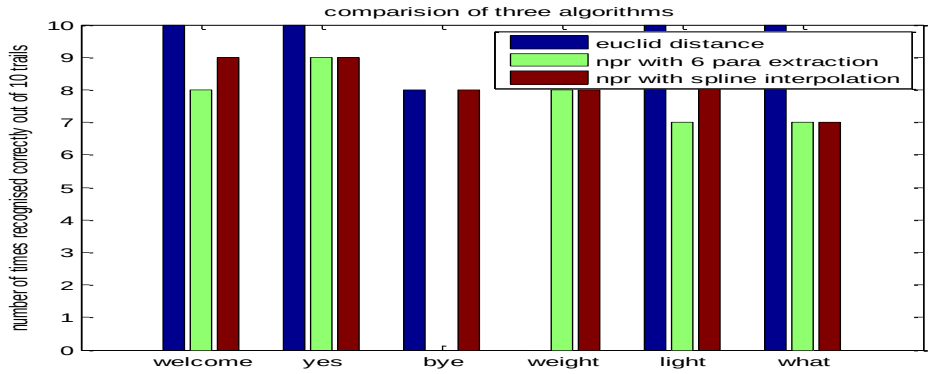


"figure7: recognition rate of each word"

From the table 3 and figure7 we infer that the least recognizing word is WHAT with seventy percent which is significant increase from zero to seventy percent when compared with previous two algorithms. The words YES, WELCOME, LIGHT has maximal recognizing rate of ninety percent and the word BYE, WEIGHT has the recognizing rate of eighty percent. These algorithm yields the overall recognizing rate of 83.3 percent. In this algorithm we achieved an increase of 3.3 percent with previous best algorithm of 80%.

4.4 Comparison of three algorithms

Comparing all the algorithms, the former algorithm is best as the efficiency range is low i.e., 70 to 90% and having overall efficiency of 83.3%, which is depicted the same in the figure8



"Figure8: comparison of three algorithms"

In first two algorithms one word is not completely recognized, which is removed with spline interpolation technique in third algorithm and we achieve an improvement of 3.3% over previous best algorithm which is based on Euclidean distance.

"V. Conclusion"

In this model, we made use of single accelerometer as we intended to transform only dominant hand movements. We proposed few algorithms which are based on Euclidian distance metric and another one based on neural network pattern recognition. We transformed six signs corresponding to ASL achieving an efficiency of 83.3%. This model is ideally suitable for animals and also for deaf and dumb community and it works in real time.

References

Books

[1] M. Birkholz, K.-E. Ehwald, P. Kulse, J. Drews, M. Fröhlich, U. Haak, M. Kaynak, E. Matthus, K. Schulz, D. Wolansky (2011). "*Ultrathin TiN Membranes as a Technology Platform for CMOS-Integrated MEMS and BioMEMS Devices*". Adv. Func. Mat. 21: 1652–

[2] M. Birkholz, K.-E. Ehwald, P. Kulse, J. Drews, M. Fröhlich, U. Haak, M. Kaynak, E. Matthus, K. Schulz, D. Wolansky (2011). "*Ultrathin TiN Membranes as a Technology Platform for CMOS-Integrated MEMS and BioMEMS Devices*".

Websites

[3] www.analog.com/static/imported-files/data_sheets/ADXL335.pdf
[4] www.microchip.com/pic16F873A
[5] category.alldatasheet.com/index.jsp?semiconductor=ZigBee/
[6] en.wikipedia.org/wiki/Euclidean distance
[7] www.mathworks.com/help/toolbox/nnet/ref/nprtool.html
[8] www.mathworks.com/matlabcentral/.../19997-neural-network-for-pat
[9] iridl.ldeo.columbia.edu/dochelp/StatTutorial/Interpolation/
[10] www.mathworks.in/help/techdoc/ref/spline.html
[11] deafness.about.com
[12] www.youtube.com/watch?v=_BF8ZH_Hut0
[13] www.animalsign.org/animalsign/kninesign-for-dogs.html