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DESIGN OF MODIFIED ICA CLASSIFIER BASED EFFICIENT SOUND-SOURCE LOCALIZATION

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Abstract: Proposed paper utilize a general source separation technique, Independent Component Analysis. Particularly, basic ICA was applied to separate mixtures for low frequency, narrow band, non-Gaussian signals by using closely spaced uni-directional microphones. localization routine worked with an average condition number for test cases. routine was tested on data collected form MATLAB standard audio files. Localizing sounds with different frequency & time domain characteristics in a dynamic listening environment is a challenging task that has not been explored in field for robotics as much as other perceptual tasks. This thesis presents an integrated auditory system localization method which can be used in humanoid robot, Sounds with different frequency components & time domain characteristics have to be localized

Keywords: Independent Component Analysis, Linear Discriminate Analysis, Discrete Wave Transform

I-INTRODUCTION

Sound localization is a listener's ability to identify location or origin for a detected sound in direction & distance. It may also refer to methods in acoustical engineering to simulate placement for an auditory cue in a virtual 3D space (see binaural recording, wave field synthesis).

The sound localization mechanisms for mammalian auditory system have been extensively studied. auditory system uses several cues as sound source localization, including time- & level-differences (or intensity-difference) between both ears, spectral information, timing analysis, correlation analysis, & pattern matching.

II-PROPOSED DESIGN

Figure 1 below shows proposed localization scenario here it can be observed that there are total 16 different sound source objects & one sound receiver in center, this situation clearly shows receiver has accuracy for observation at 360/16 = 22.5 degree, hence if source objects move by 22.5 degree proposed work will clearly recognition that.

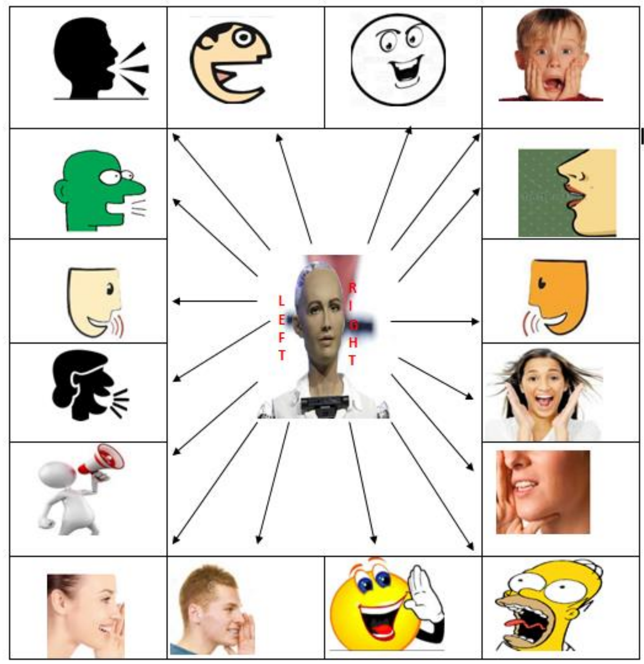

Figure 1 Audio localization Precision in Proposed Method

The position for objects can be monitor with time difference between right & left sensor & distance for object can be monitor with amplitude for source object.

In figure 2 below T1 is is distance from object & T1 can be computed by cross correlation between average amplitude for different signals it tells object location distance. T2 & T3 time difference can be computed as locating object after its distance observation, values for T2 & T3 helps us to identify whether object is in left or right & more precise observation can be computed with accurate rectification for difference between T2 & T3 exact. In figure 2 sound source ‘C’ has bigger difference (time taken form source to receiver T1) from receiver as compare with sound source ‘A’ & Sound source ‘B’, hence receiver will let know that source

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'C' is far as compare with Source 'A' & source 'B'. In same example source 'A' & source 'B' taking same T1 time (source to receiver) in this case now receiver need to identify location for sources & because receiver is a small object & there is very small difference between its left & right audio sensor a accurate method required to compute difference between T2 (time taken form source to receiver Right sensor) & T3 (time taken from source to receiver left sensor), hence Cross correlation cannot be used & ICA is been used instead for cross correlation as more accurate differentiate

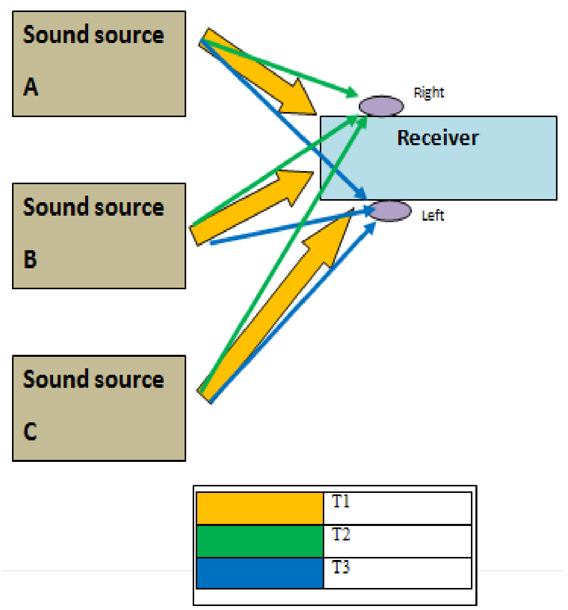

Figure 2 Propose techniques as identification

If T2 > T3 & T1 is same as both sources means source is in left side

If T3 > T2 & T1 is same as both sources means source is in right side

The localization device measure time on behalf for average amplitude for sound source at each 1 ms. Let say x(n) is sound signal receiver from any source placed at any location in that case average amplitude can be computed from below formula

$$A = \frac{\sum_{n=0}^{\frac{Fs}{1000}} x(n)}{Fs/1000}$$

The receiver will get same amplitude information from many different sound sources it keeps compute average amplitude in each 1 ms, & then it finds maximum A out for all receiver sound signals & Minimum A from all sound signals, values for A gives exact idea about distance.

Maximum A = minimum distance

Minimum A= Maximum Distance

The block diagram below shows how to know position for sound source after computing distance.

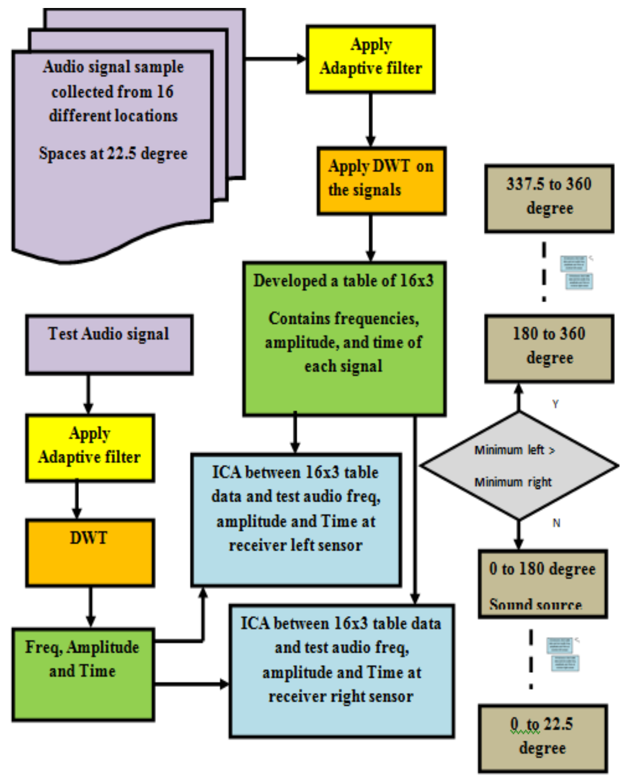

Figure 3 block diagram

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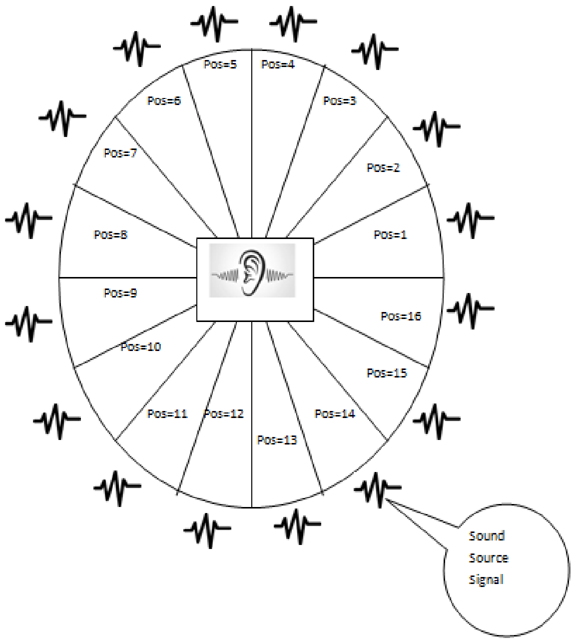

Figure 4: observe sound source angular precision

Proposed work It will give us exact audio source angle with precision for 22.5 degree from where test sound source came. Pos be can be anyone out for 1, 2, 3….16.

Pos	Localization (Angle position for source from receiver)
1	0-22.5
2	22.5-45
3	45-67.5
4	67.5-90
5	90-112.5
6	112.5-135
7	135-157.5
8	157.5-180
9	180-202.5
10	202.5-225
11	225-247.5
12	247.5-270
13	270-292.5
14	292.5-315
15	315-337.5
16	337.5-360

Table 1 sound source Localization accuracy

IV-RESULTS

Results for Source Localization: source localization routine was tested on signals simulated as a geometry that consists for microphones placed at tips for a tetrahedral & a source that could be placed anywhere in 3D. source localization routine turned out being robust with a condition number in order for magnitude for 1, as sources that are close to center for tetrahedral. This means a percent error introduced into locations for microphones gets amplified by a factor with order for magnitude for 1 before manifesting itself as a percent error in location for source determined.

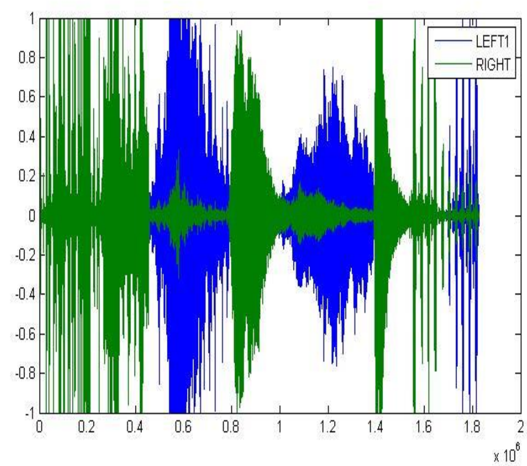

Figure 5 Audio signal having sound samples coming from 16 different angels

Proposed work is supporting 16 audio channels as 360 degree rotation

Hence precision for

360/16 = 22.5 degree

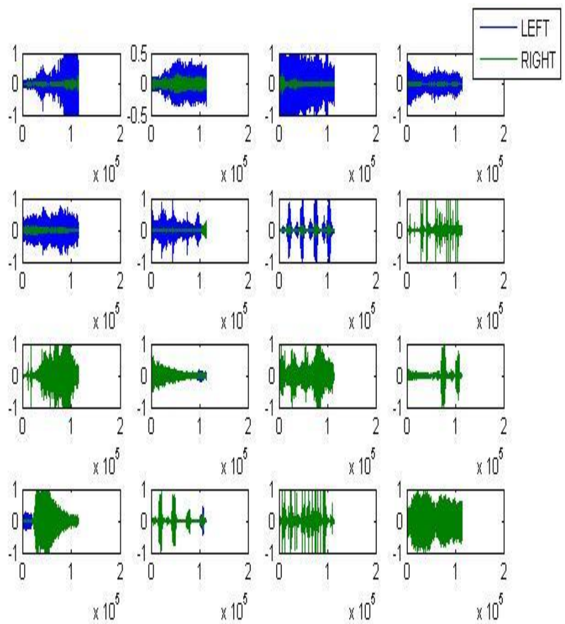

Figure 6: 16 Audio samples from 16 different locations spaced at 22.5 degree each

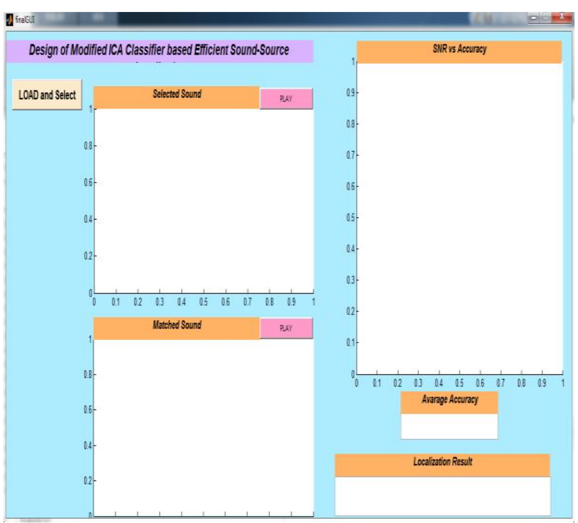

Figure 7: Proposed GUI

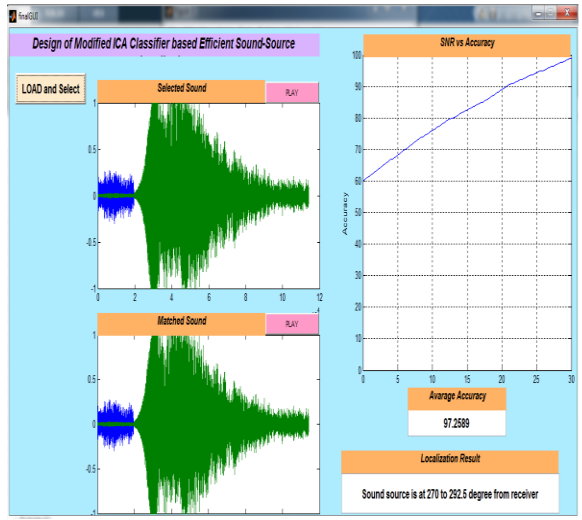

Figure 8 Results after sound localization in GUI

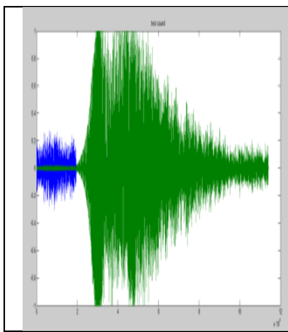	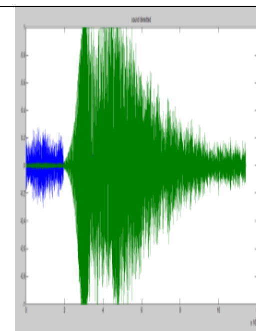
Test Sound source which need to detect	Sound signal detected by proposed method

Figure 9 Sound Signal recognition

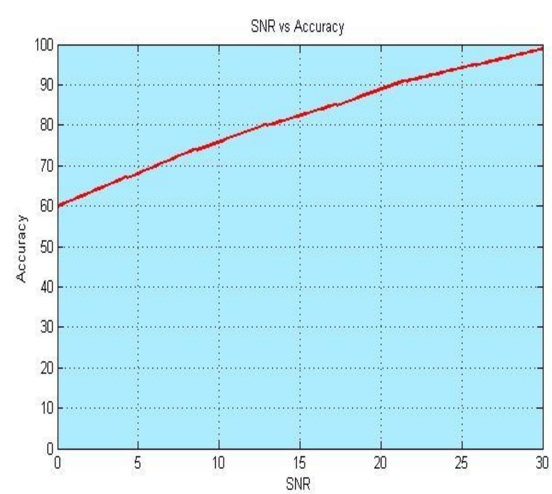

Figure 10: SNR vs Accuracy as proposed wok

V-CONCLUSION

This paper has put forward a sound source localization method based on ICA classifier. Using GCC-PHAT function with further processing as feature vector, then compare performance for ICA classifier & Naive-Bayes classifier. According to simulation result, with increasing for reverberant time, localization approach based on ICA classifier shows its higher localization performance than Naive-Bayes classifier. Therefore, in such hash environment, it is better to use ICA classifier to locate sound source. In addition, in this simulation, we just use one frame test data & two microphones. So it is obvious that multiple microphones & multiple test frames to be used in practice will improve performance greatly

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