IEEE International Symposium on Multimedia (ISM2012)

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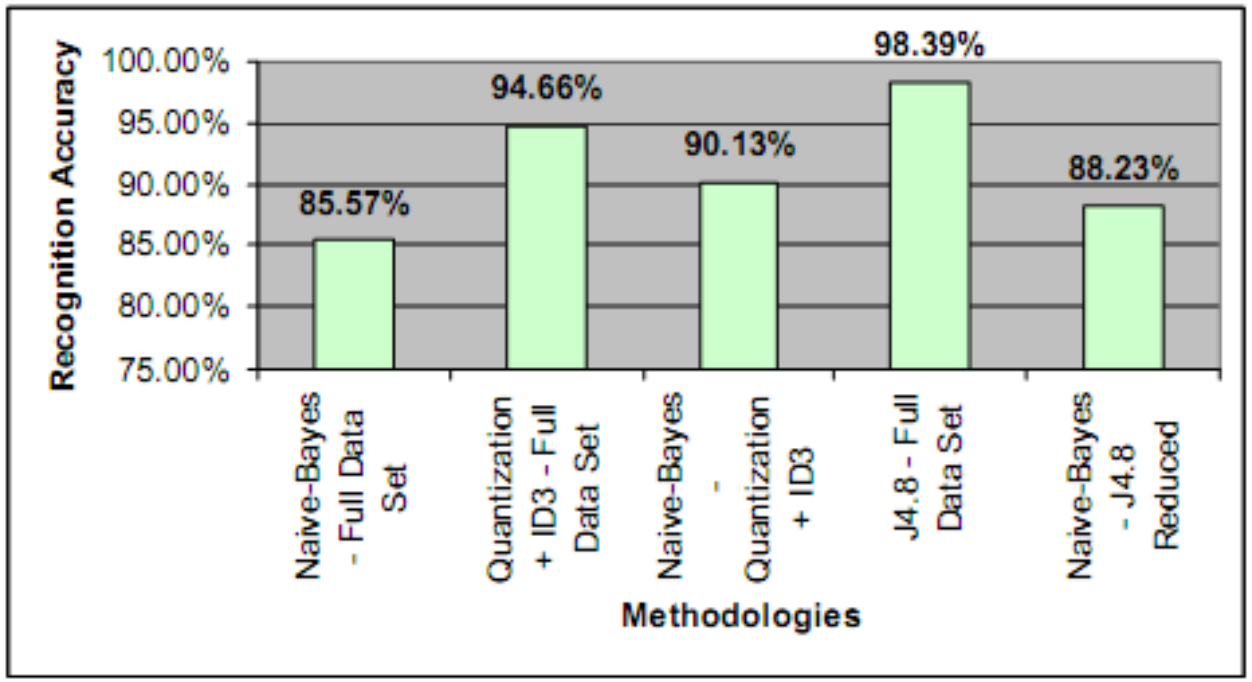
Spectral Noise Gate Technique Applied to Birdsong Preprocessing on Embedded Unit

Federal University of Technology - Paraná Brazil,
12/11/12

Introduction – Bird Automatic Classification



(Vilches et. al., 2006)

Introduction – Bird Automatic Classification

	Feature Set		
Classifier	Sound Ruler	IOIHC	MARSYAS
Naïve Bayes	99.7	43.5	86.9
kNN $(k = 3)$	96.8	57.4	98.4
J4.8	99.0	61.0	99.7
MLP	98.7	68.0	99.7
SVM (Polynomial)	97.8	53.5	99.4
SVM (Pearson)	99.4	64.3	99.4

Lopes, Silla, Koerich e Kaestner (2011)

Introduction – Problems

- Concern with the environment;
- Fauna control;
- The miss of additional information;
- Human and animal safety.
- **The difficulty with real samples and situations;**

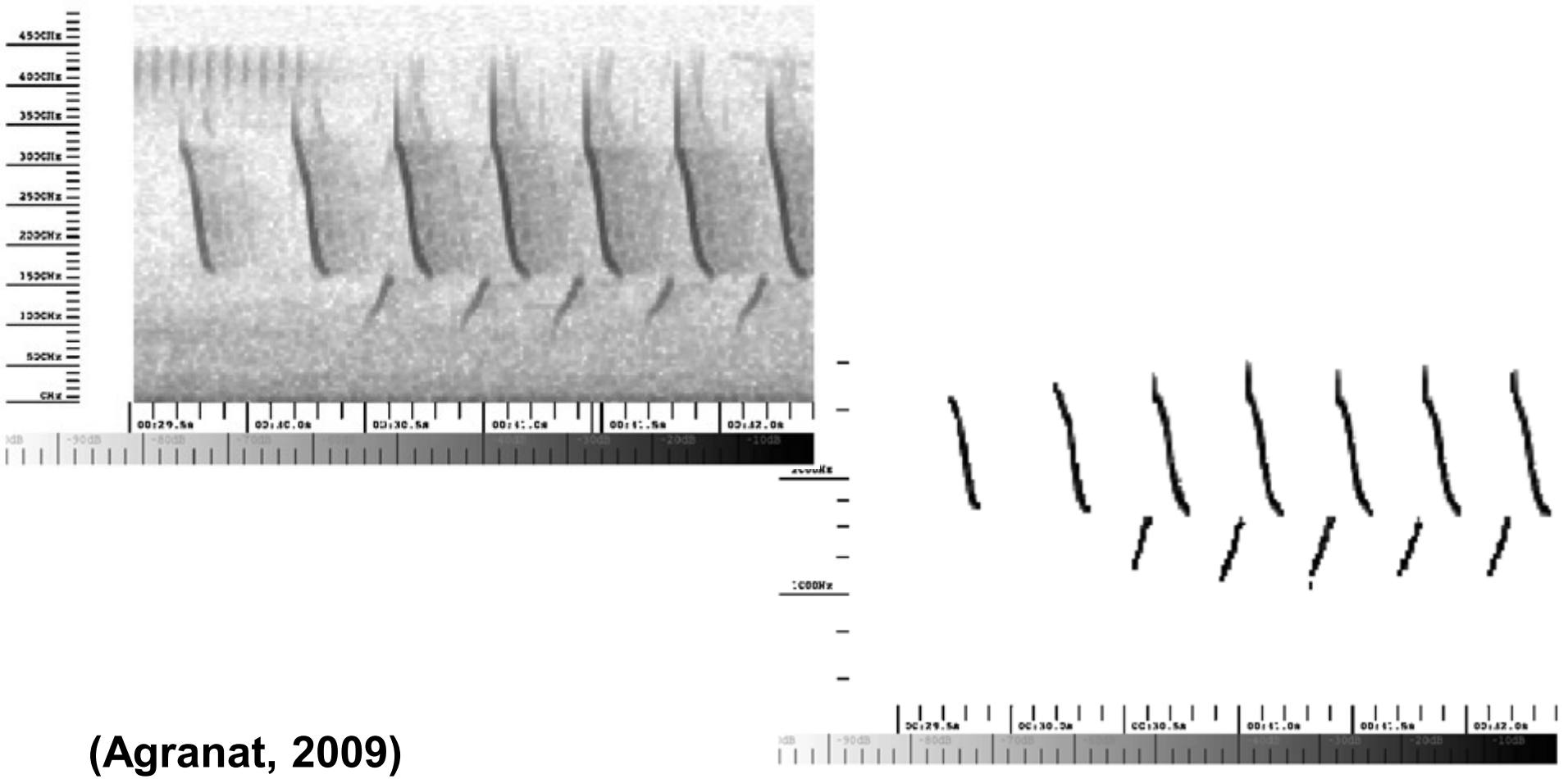
Introduction – Proposal

- Micro-controlled embedded system;
- Pre-process audio signal;
- Suitable real environments;
- Extract sound characteristics;

Audio Processing

- A wide variety of noises in a real envinroment;
- The large spectral frequency width;
- XenoCanto community, Cornell Lab of Ornitology, CENIPA, ...

Audio Processing

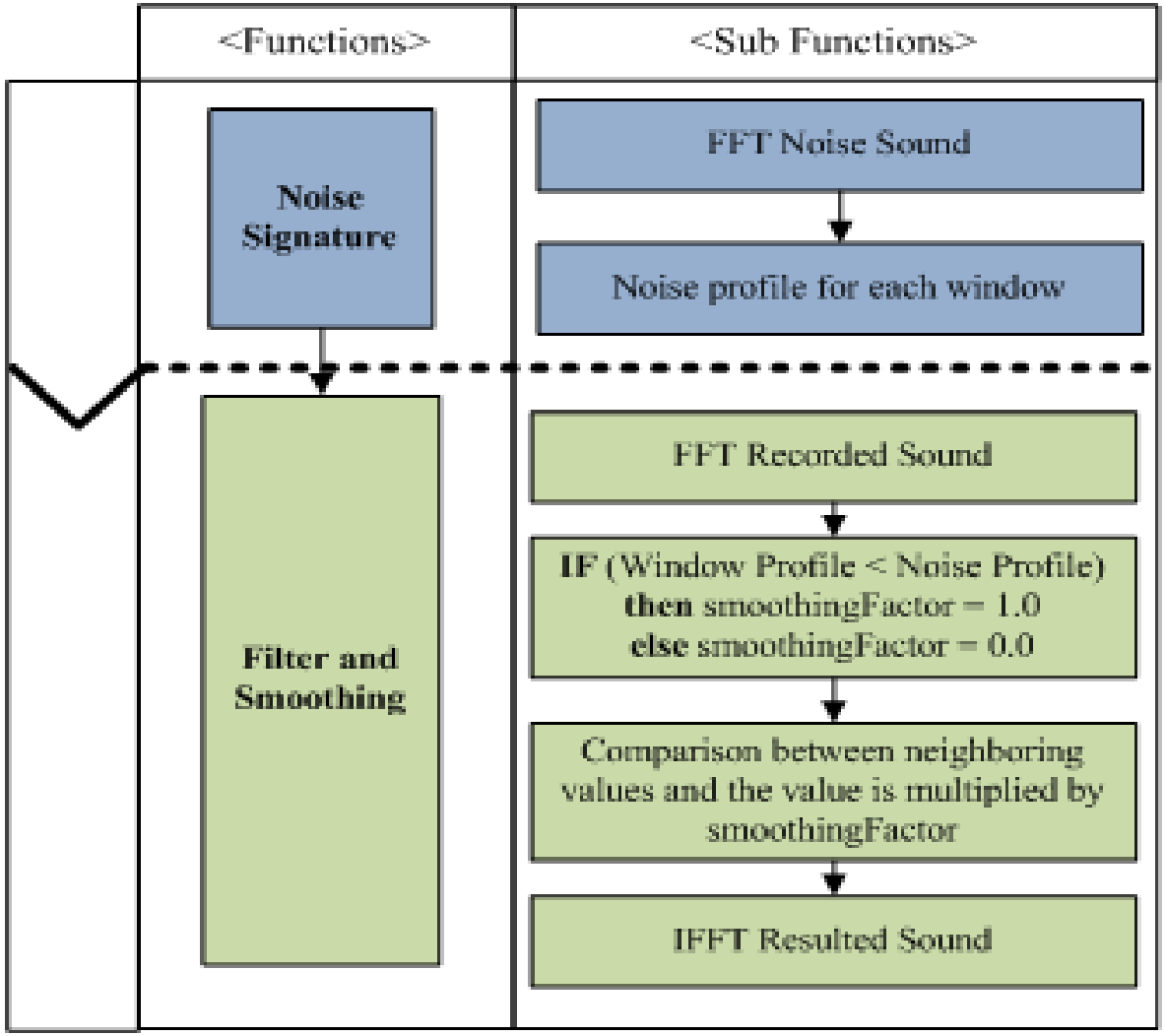


(Agranat, 2009)

Proposed Approach

- To delivering to the automatic classify a clean and prepared sound:
  - Preparation and filtering the signal;
  - Feature extraction;
  - Materialization in a embedded environment;

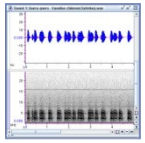
Proposed Approach – S. N. G. Algorithm

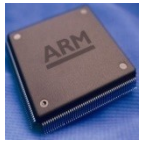


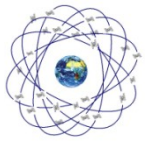
Proposed Approach – Feature Extraction

- Skewness
- Kurtosis
- Spectral Centroid
- Spectral Rolloff
- Zero Crossing Rate

Proposed Approach – Hardware Architecture







- ARM920T
- SPI, USB host, RS232, PWM, DMA, RTC, AC97, I2C ...
- AD Conversor, 8 channels,10 bits resolution, 500 KSPS;
- Linux kernel 2.6.32.2;
- ARM GCC 4.3.2 cross compiler.

Experiments - Recording

- Recording;
  - Mono channel microphone;
  - Samples stored in memory FLASH; and
  - 8 or 16 bits, up to 44,100 Hz of sample rate.

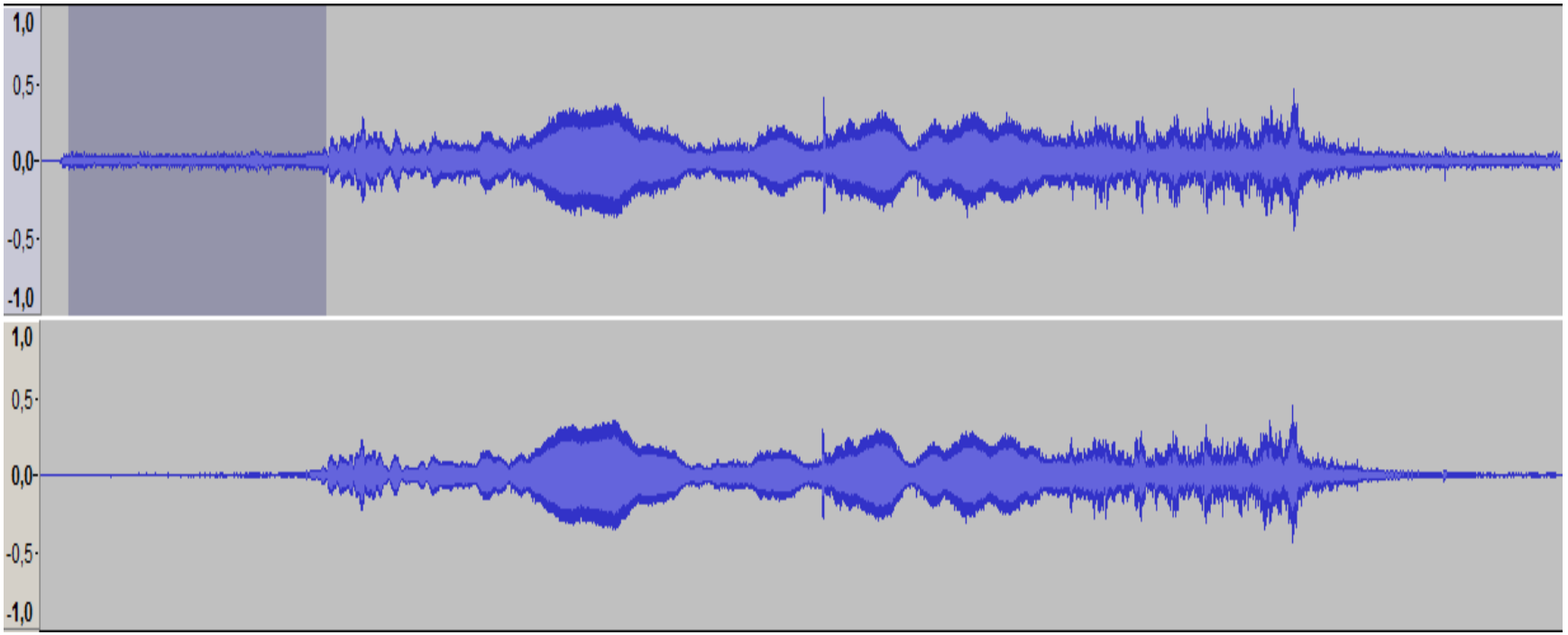
Experiments – Spectral Analysis

- Spectral Analysis and pre-processing;
  - FFT
  - Windows Function: Hamming, Hanning, Bartlett.

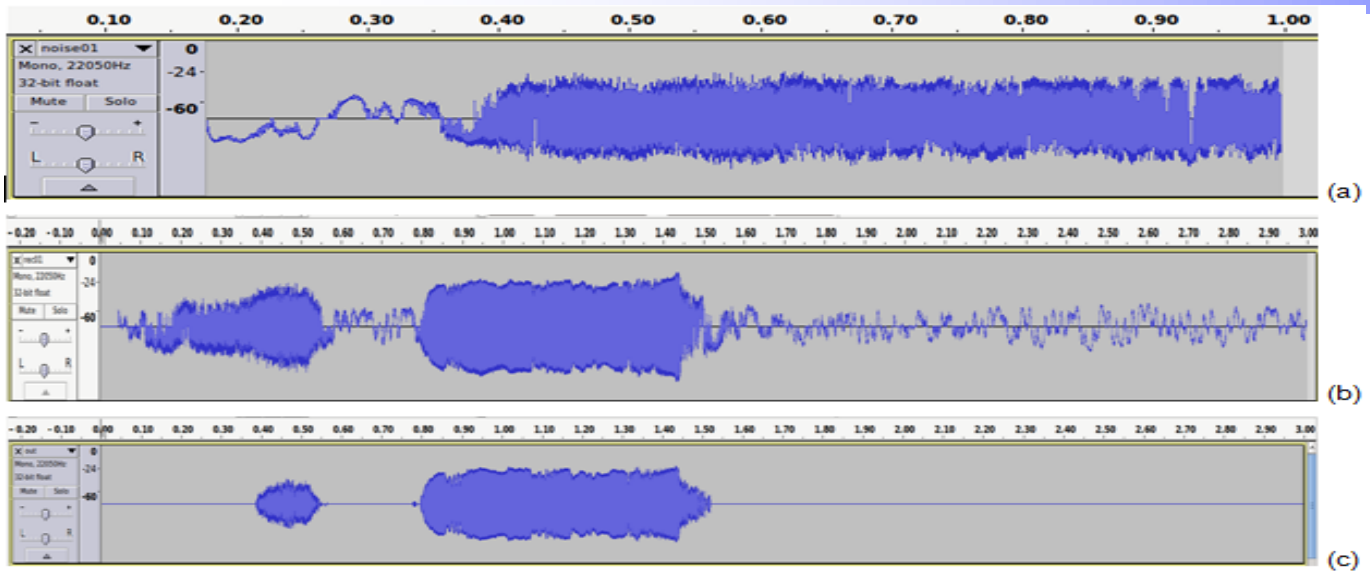
Experiments - Feature extraction

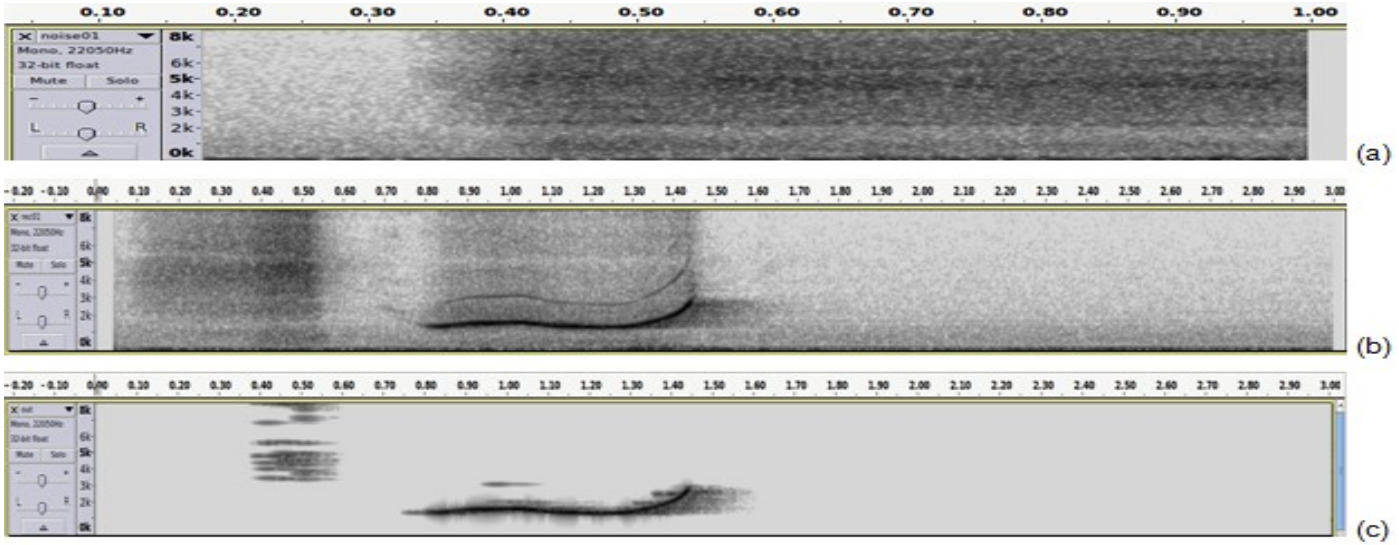
Characteristic	*Value*
Total size WAV. file	48,044
Total size fo the data	24,000
Number of bits per sample	16
Recording data and hour	Fri Mar 16 10:36:07 2012
Zero crossing rate	0.0875748
Data Sum	-1.39276
Values not equal zero	23,191
Employed windowing	BARTLETT
Centroid of the data	0.763369
Skewness	0.735164
Data Kurtosis	121.12
Data Rolloff	1,991.21

Experiments – Example of the use of the filter

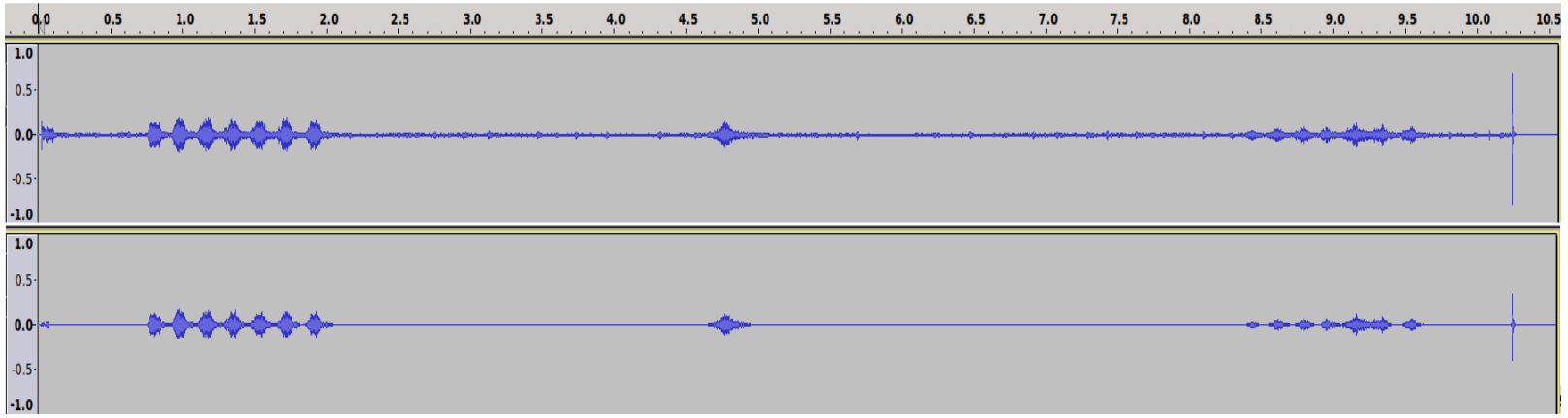


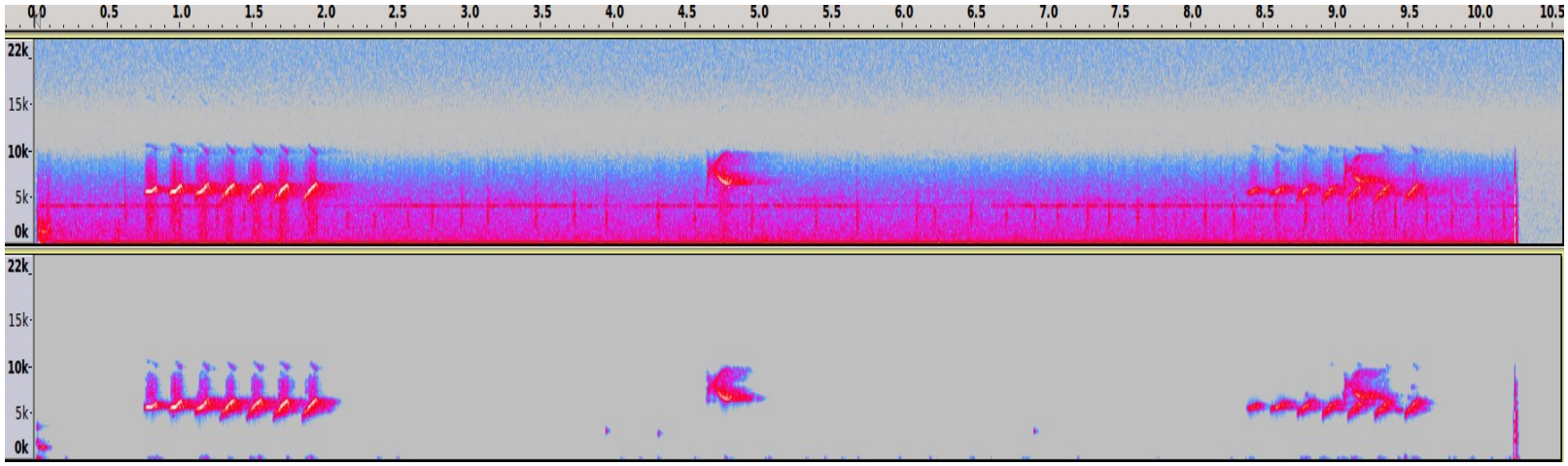
Experiments



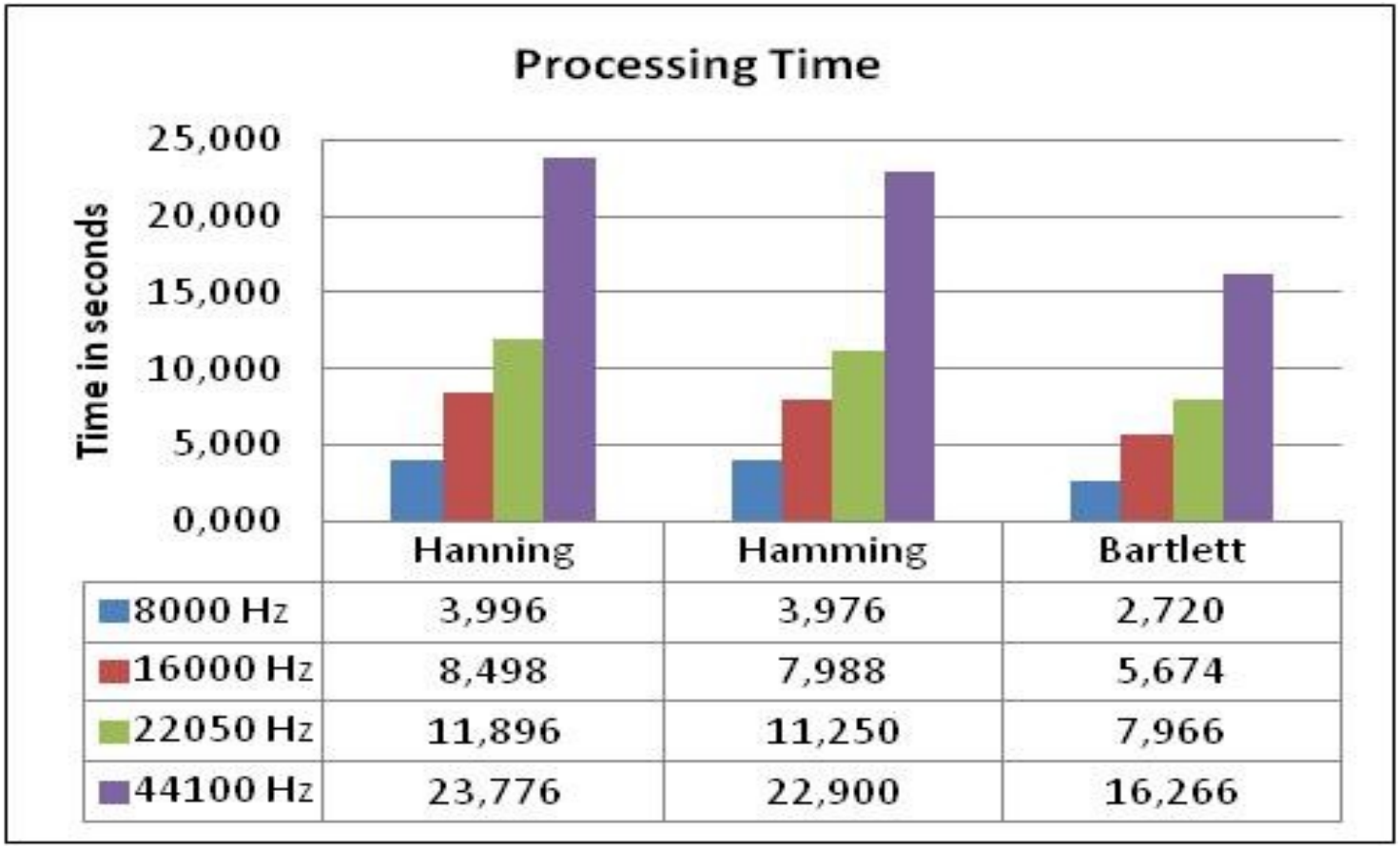


Discussion


0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5
1.0
0.5
0.0
-0.5
-1.0
1.0
0.5
0.0
-0.5
-1.0

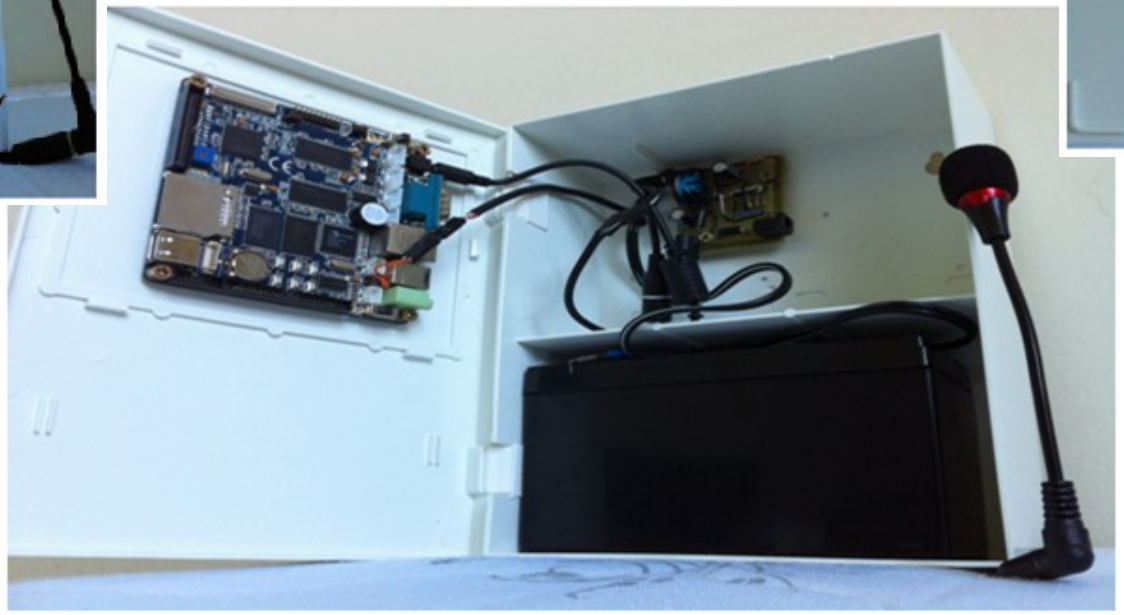

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5
22k
15k
10k
5k
0k
22k
15k
10k
5k
0k

Discussion



	Hanning	Hamming	Bartlett
8000 Hz	3,996	3,976	2,720
16000 Hz	8,498	7,988	5,674
22050 Hz	11,896	11,250	7,966
44100 Hz	23,776	22,900	16,266

Final Remarks



Final Remarks

- *Softwares*, utilized libraries:
- Raven Lite – Free Version, Sound Ruler, Audacity, MASYAS, SoX, ...
  - ARM-linux, GCC e G++, Embedded Linux

Final Remarks

- Acknowledgment
  - Araucaria Foundation and CNPQ.

Main References

- E. Vilches, I.A. Escobar, E.E. Vallejo and C.E. Taylor, “Data mining applied to acoustic bird species recognition,” in Proceedings of the 18th International Conference on Pattern Recognition (ICPR ’06), vol. 3, pp. 400–403, Hong Kong, August 2006
- I. Agranat, “Automatically identifying animal species from their vocalizations,” 2009 Acoustics. Inc., Concord, Massachusetts, p. 22, 2009.
- M. T. Lopes, L. L. Gioppo, T. T. Higushi, Celso A. A. Kaestner, C. N. Silla Jr., A. L. Koerich: Automatic Bird Species Identification for Large Number of Species. IEEE International Symposium on Multimídia, Dana Point, CA, USA, December 2011: 117-122.
- C. Silla, C. A. A. Kaestner e A. L. Koerich, “Automatic Music Genre Classification using Ensemble of Classifiers,” Proceedings of the IEEE International Conference on Systems, Man and Cybernetics (SMC'07), Montreal, Canada, pp. 1687-1692, Oct. 2007

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