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Wavelet Domain Features For Infant Cry classification

S. Blessy*, T. Jayasree**

*Ph.d Research Scholar, ECE, Department, Government College of Engineering, Tirunelveli
**Assistant Professor, ECE, Department, Government College of Engineering, Tirunelveli

A B S T R A C T

Newborn cry is a biological signal through which an infant interacts with its caregivers. It also includes important information regarding the infant's condition. Infants make this sound in reaction to a stimulus, which might be pain, discomfort, emotional need for attention, illness, environmental variables, or hunger/thirst. This study created the baby's voice-based speech processing sound recognition system. The baby's cry is recorded using the audio record tool, and the extraction feature is obtained using Wavelet Transform. This paper discusses the recognition of properties in biological signals, especially newborn cries. The Wavelet Transform is a mathematical method that is used to extract features related with specific cries like hunger, discomfort and pain that afflict newborns.

Keywords: Wavelet Transform, features, infant, cry, frequency, noise

1.Introduction

When a new baby is born into the world, the first thing he or she does is cry. The infant's cry is typical and signifies that the baby was delivered securely and properly. Because the cry of newborn newborns is one type of communication from the baby, the baby can connect with both parents by crying [1]. However, there is frequently a lack of suitable management for new parents with infants. Crying is a baby's only means of communicating with his or her surroundings. Specialists have determined that the newborn scream reflects the baby's physical, pathological, and/or mental status [2].
The Fourier transform has been an essential basis in the study of stationary signals, but new tools have emerged that may be used to provide another method in the analysis of signals, particularly those with abrupt changes and quick transience or that are not stationary in nature [3], [4]. The Wavelet transform is an appealing technique for studying these types of signals.

2.Methodology

2.1. Wavelet Transform

A wavelet is a signal or waveform with a finite duration and an average value of zero. The Wavelet analysis allows for the use of large time intervals in segments where high precision is required in low frequency and smaller time intervals in segments where high frequency information is required [5]. The Wavelet transform of a function f(t) is the decomposition of f(t) into a group of functions called Wavelets that form a basis.

$$W_f(s,\tau)=\int f(t)\psi^*_{s,\tau}(t)\,dt.$$

They are formed by translating and changing the scale of the same function (t), known as the Wavelet mother, and are defined as:

$$\psi_{s,\tau}(t)=\frac{1}{\sqrt{s}}\psi\left(\frac{t-\tau}{s}\right)$$

Where (s) represents the scale factor and () represents the translation factor.
In general, the application of this mathematical technique is based on breaking the signal elements into numerous layers or sublevels, which is a type of filtering of high and low frequency levels from a Wavelet mother.

* *Corresponding author.* Tel.:+919486324974
E-mail address: jayasree@gcetly.ac.in

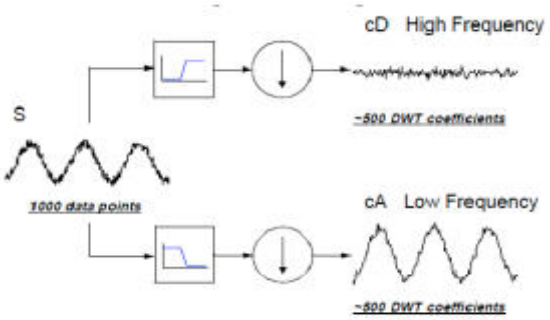

Fig. 1. First level of decomposition of a signal

Figure 1 depicts the first level of signal decomposition. The signals evaluated by this mathematical technique originate from an infant cry data set called Chillanto (property of INAOE1), which had previously been identified and catalogued by professionals in various fields [6], [7].

The Wavelet Transform has a high time resolution, a low frequency resolution, and a low time resolution at low frequencies. It has the capability of presenting the signal in several frequency components via signals on the filter and signal decomposition, with the goal of obtaining a signal composition at high and low frequencies [8].

The original audio signal is missed throughout this wavelet decomposition process due to two filters, High Pass Filter (HPF) and Low Pass Filter (LPF) (LPF). The HPF findings were used to evaluate high frequencies, while the LPF data were used to study low frequencies [8], [9]. The signal equation at level 1 is given by

$x[n] = \sum (yhigh[k].\ [-n + 2k]) + (ylow[k].\ h[-n + 2k]$

3.Results and Discussion

Three alternative newborn cry signals are offered as experiments for this paper. Figures depict the primary degrees of disintegration of a newborn cry signal for hunger, discomfort, and pain.

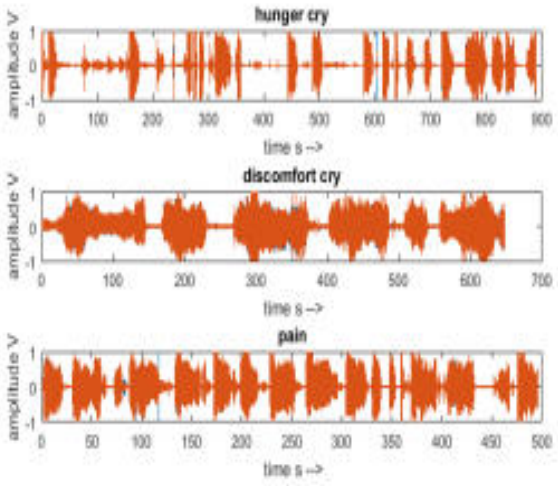

Fig. 2(a) First level of decomposition of a signal

Figure 2(a) depicts signals produced from the analysis of hunger, discomfort, and pain newborn cry, with the original signals, the first level of detail from half of the signal values utilised and a high pass filter, and the final approximation level with a low pass filter [10-13]. In the graphics below, the fundamental levels of breakdown of a newborn cry signal are presented.

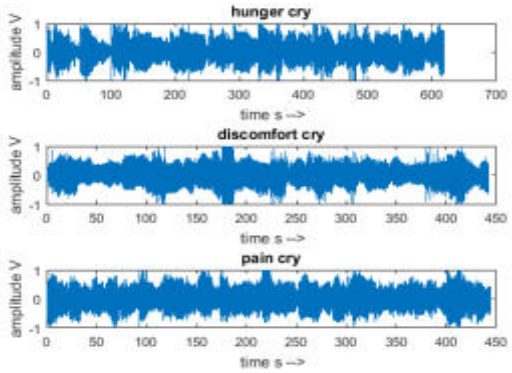

Fig. 2 (b): After silence removal

Figure 2(b) specialised literature establishes that the baby scream alters once quiet circumstances are removed. This is seen in images depicting initial signals from hunger, discomfort, and pain newborn cry signals.

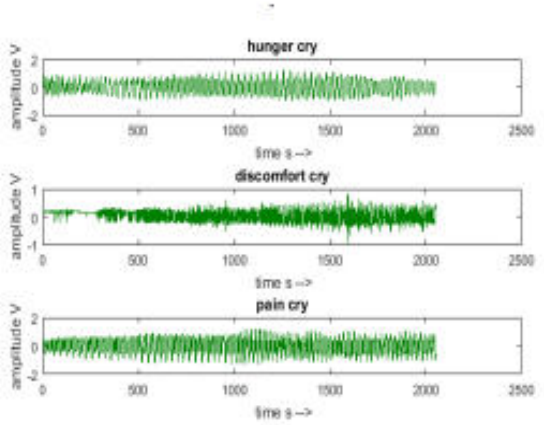

Fig.3 Wavelet Transformed cry signal for one segment

Figure 3 depicts the Wavelet Transformed cry signal for one segment; hence, Wavelet analysis enables for the accurate location of points in time where extremely well defined properties of separate cry signals occur.

4. Conclusion

When the study of the three distinct newborn cry signals performed in this work is compared, it is possible to infer that the Wavelet transform is a highly strong tool for locating features of diverse cry signals. The cry signal analysis reveals components at both high and low frequencies, with extremely brief spasms. The examination of the discomfort cry signal revealed that higher low frequencies predominate and the spasms are protracted with little bandwidth. The study of the hunger cry signal revealed components in both low and high frequencies, with a dominating bandwidth and no spasms.

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