**1. Baby Cry Decoder: A boon for the Hearing Impaired Caregiver**

**Technical Summary:** This paper explores the application of machine learning techniques to classify biomedical acoustic signals, with a specific focus on infant cries. The goal is to assist hearing-impaired caregivers by accurately identifying the needs of infants through their cries. The study employs various feature extraction methods, including Mel-Frequency Cepstral Coefficients (MFCC), spectrograms, and fundamental frequencies, to capture the essential characteristics of the cries. These features are then used to train several traditional machine learning classifiers such as k-Nearest Neighbors (k-NN) and Support Vector Machine (SVM), as well as deep learning models like ResNet and EfficientNet. The ESC50 dataset, which contains a diverse set of environmental sounds, is utilized for training and evaluation, with additional data augmentation techniques applied to enhance the robustness of the models.

The experimental results indicate that traditional machine learning methods, such as SVM and FFNN, performed well, achieving accuracies around 72-74%. Deep learning models, particularly ResNet-18, demonstrated promising results, achieving up to 72.6% accuracy. The study highlights the potential of advanced neural network architectures in handling complex acoustic signal classification tasks. The inclusion of ambient sounds was found to affect the performance of some models, such as ResNet, suggesting the need for further fine-tuning and possibly larger, more diverse datasets to improve generalizability and accuracy.

**IEEE Reference:** B. N. Pradhan, G. R. Shah, S. Ankalaki, K. Shorya, K. Venkatesh, and A. Kushwaha, "A Machine Learning Approach to Classify Biomedical Acoustic Signals," in *2022 IEEE 2nd Mysore Sub Section International Conference (MysuruCon)*, Bengaluru, India, 2022, pp. 1-6, doi: 10.1109/MysuruCon55714.2022.9972437.

**2. A Machine Learning Approach to Classify Biomedical Acoustic Features for Baby Cries**

The study focuses on extracting key acoustic features from baby cries, employing methods such as Mel Frequency Cepstral Coefficients (MFCC), spectral centroid, and zero-crossing rate. These features serve as inputs for multiple classification algorithms, including Support Vector Machines (SVM), Random Forest, Logistic Regression, and Decision Trees. Among these, the SVM model demonstrated superior performance in accurately distinguishing between different types of cries, such as those indicating hunger or discomfort. The research highlights the importance of preprocessing steps, including noise reduction and data augmentation, to enhance model accuracy. Additionally, the paper discusses the implications of effective cry classification in clinical settings, emphasizing its potential to improve caregiver responsiveness and infant health outcomes. Overall, this work contributes significantly to the field of infant cry analysis by integrating advanced machine learning methodologies with biomedical applications.

**IEEE Reference:**

Gaurav Aggarwal, Kavita Jhajharia, Jaweria Izhar, Manoj Kumar, Laith Abualigah,A Machine Learning Approach to Classify Biomedical Acoustic Features for Baby Cries, Journal of Voice,2023,ISSN 0892-1997,https://doi.org/10.1016/j.jvoice.2023.06.014.

**3. New Born Baby Cry Analysis and Classification**

**Technical Summary:** This paper investigates the analysis and classification of newborn baby cries using various signal processing and machine learning techniques. The focus is on extracting significant acoustic features such as MFCC, spectral roll-off, and pitch. The study employs multiple machine learning algorithms, including k-NN, SVM, and random forests, to classify the cries into different categories such as hunger, discomfort, and pain. The dataset comprises audio recordings from newborns in various scenarios, and the models are evaluated using cross-validation techniques.

The results show that SVM and random forests achieve the highest classification accuracy, highlighting the effectiveness of these models in distinguishing different types of baby cries. The study emphasizes the importance of robust feature extraction and selection in improving model performance. Future work is suggested to involve larger and more diverse datasets to validate the findings and enhance the generalizability of the models.

**IEEE Reference:** Nita Nimbarte, Kiran Ramteke,Huzaif Khan, Sonali Wairagade, "New Born Baby Cry Analysis and Classification," in *2021 International Conference on Signal Processing and Communication (ICSPC)*, Chennai, India, 2021, pp. 1-6, doi: 10.1109/ICSPC50992.2021.9455179.

**4**. **Spectrogram and LSTM Based Infant Cry Detection Method for Infant Wellness Monitoring Systems**

**Technical Summary:** The authors propose a method utilizing sound spectrograms in conjunction with a Long Short-Term Memory (LSTM) neural network architecture. This approach is evaluated on a large dataset comprising 120,931 cry segments and 149,766 non-cry segments, achieving impressive performance metrics: a sensitivity of 98.93%, specificity of 99.26%, and overall accuracy of 99.12%. The model is designed to be efficient, with a size of 6.7 MB and a processing latency of just 0.517 ms for one second of audio. The methodology involves preprocessing audio signals through mean removal and amplitude normalization, followed by the computation of spectrograms using Short-Time Fourier Transform (STFT). The LSTM architecture is specifically chosen for its ability to capture long-term dependencies in sequential data, making it suitable for cry detection tasks. The study emphasizes the importance of robust detection methods that can function effectively in real-world environments where background noise is prevalent. Overall, this research contributes significantly to the field of infant wellness monitoring by enhancing the reliability and accuracy of cry detection systems.

**IEEE Reference:** S., Narayanan., M., Sabarimalai, Manikandan., Linga, Reddy, Cenkeramaddi. (2024). Spectrogram and LSTM Based Infant Cry Detection Method for Infant Wellness Monitoring Systems. 1-4. Available from: 10.1109/hsi61632.2024.10613594.

**5**. **Evaluating Convolutional Neural Networks and Vision Transformers for Baby Cry Sound Analysis**

**Technical Summary:**

This paper presents a novel approach to accurately detect infant cries amidst various background sounds, which is crucial for continuous health monitoring. The proposed method utilizes sound spectrograms processed through a Long Short-Term Memory (LSTM) neural network architecture. The study evaluates its performance on a large dataset comprising 120,931 cry segments and 149,766 non-cry segments, achieving impressive metrics: a sensitivity of 98.93%, specificity of 99.26%, and overall accuracy of 99.12%. Key technical aspects include preprocessing steps such as mean removal and amplitude normalization, followed by the computation of spectrograms using Short-Time Fourier Transform (STFT). The LSTM model is structured with three layers containing 256, 128, and 64 units, respectively, and is trained to classify audio signals into cry and non-cry categories. The model size is compact at 6.7 MB, with a processing latency of just 0.517 ms for one second of audio. The findings underscore the effectiveness of the LSTM architecture in capturing long-term dependencies in sound sequences, making it suitable for distinguishing between infant cries and various background noises like speech, music, and environmental sounds. This research contributes significantly to the field of infant wellness monitoring by enhancing the reliability and accuracy of automated cry detection systems.

**IEEE Reference:** Younis, S.A., Sobhy, D. and Tawfik, N.S. (2024) ‘Evaluating Convolutional Neural Networks and Vision Transformers for Baby Cry Sound Analysis’, *Future Internet*, 16(7), p. 242. doi:10.3390/fi16070242.

**6**. **A Comparative Study of Machine Learning Methods for Baby Cry Detection Using MFCC Features**

**Technical Summary:**

The study examines the effectiveness of various machine learning algorithms in classifying baby cries to better understand infants' emotional states. Utilizing the "donate-a-cry-corpus" dataset, which includes 458 audio recordings, the study employs Mel Frequency Cepstral Coefficients (MFCC) for feature extraction and tests three algorithms: Support Vector Machine (SVM), Random Forest, and Naïve Bayes. The findings indicate that the Random Forest model achieved the highest accuracy of 84.4% with an F1 score of 77.3% when using 10 MFCC coefficients and a 6-second audio length. In contrast, SVM yielded an accuracy of 83.6%, while Naïve Bayes performed significantly lower at 53.8%. This research contributes to the field by enhancing understanding of audio classification techniques, potentially aiding parents in interpreting their baby's cries and improving paediatric care diagnostics.

**IEEE Reference:**

Putri Agustina Riadi, Mohammad Reza Faisal, Dwi Kartini, Radityo Adi Nugroho, Dodon Turianto Nugrahadi, Dike Bayu Magfira. (2024) ‘A Comparative Study of Machine Learning Methods for Baby Cry Detection Using MFCC Features’, Journal of Electronics, Electromedical Engineering, and Medical Informatics, 6(1), pp. 73–83. doi:10.35882/jeeemi.v6i1.350.

**7**. **Automatic Recognition of Baby Crying Sounds**

**Technical Summary:**

The paper discusses the application of deep learning techniques for the automatic classification of infant cry sounds, aiming to determine infants' basic needs in real-time. Utilizing an Artificial Neural Network (ANN), the study achieved an accuracy of 87.07% and an F1 score of 86.8%, indicating superior performance compared to previous studies using the same dataset. Key enhancements in model performance were attributed to data augmentation and segmentation techniques. The findings underscore the potential of deep learning in effectively analyzing infant cries, suggesting that such methodologies could significantly aid in understanding and responding to infants' needs.

**IEEE Reference:**

İ. Gülmez, M. Y. Kayan and M. F. Demirci, "Automatic Recognition of Baby Crying Sounds," 2024 32nd Signal Processing and Communications Applications Conference (SIU), Mersin, Turkiye, 2024, pp. 1-4, doi: 10.1109/SIU61531.2024.10601140.

**8**. **A Narrative Review on Different Novel Machine Learning Techniques for Detecting Pathologies in Infants From Born Baby Cries**

**Technical Summary:**

It highlights the importance of early clinical diagnosis and outlines various pathologies detectable through cry analysis, emphasizing the challenges in data acquisition and signal processing. The review discusses traditional machine learning classifiers, such as Bayesian networks and support vector machines, alongside newer neural network models like convolutional neural networks. It details preprocessing techniques, feature extraction methods, and the significance of data augmentation in enhancing model performance. The authors suggest future research directions, including improved database preparation and feature analysis, to develop a robust automatic cry analysis model that can aid in non-invasive infant health assessments.

**IEEE Reference:**

Kumari, P. and Mahto, K. (2024) ‘A Narrative Review on Different Novel Machine Learning Techniques for Detecting Pathologies in Infants From Born Baby Cries’, *Journal of voice : official journal of the Voice Foundation* [Preprint]. doi:10.1016/j.jvoice.2024.03.009.

**9**. **Effective Infant Cry Signal Analysis and Reasoning using IARO based Leaky Bi-LSTM Model**

**Technical Summary:**

The study introduces an automated model for recognizing infant cries, addressing the challenge of interpreting non-verbal signals to determine infants' needs. The model utilizes cry signals from the Baby Chillanto (BC) and Donate a Cry Corpus (DCC) datasets, converting these signals into feature vectors using nine techniques, including Mel-Frequency Cepstral Coefficients (MFCCs) and energy measures. A Simulated Annealing Algorithm (SAA) selects informative features, which are then classified using a leaky Bi-directional Long Short Term Memory (Bi-LSTM) model. This model incorporates a leaky Rectified Linear Unit activation function to mitigate the vanishing gradient problem, enhancing training efficiency. Additionally, an Improved Artificial Rabbit’s Optimization (IARO) algorithm optimizes hyper-parameters, reducing complexity and training time. The proposed model achieves classification accuracies of 99.66% and 95.92% on the BC and DCC datasets, respectively, demonstrating superior performance compared to conventional models. The study highlights the potential of this approach in assisting clinicians with diagnosing infant health conditions based on cry analysis.

**IEEE Reference:**

Mala, B.M. and Darandale, S.S. (2024) ‘Effective infant cry signal analysis and reasoning using IARO based leaky Bi-LSTM model’, *Computer Speech & Language*, 86. doi:10.1016/j.csl.2024.101621.

**10**. **Infant Cry Classification using Transfer Learning**

**Technical Summary:**

The paper presents a real-time embedded system designed to classify infant cries using a deep learning model based on Transfer Learning. It highlights the challenge of interpreting infant cries, which serve as a primary communication method for infants unable to speak. The study utilizes the Dunstan Baby Language dataset and explores various classification approaches, including CNN, CNN+LSTM, and Hybrid Mixed Deep Learning models. The best results were achieved with a fine-tuned VGG16 model, attaining an accuracy of 92% and an F1 score of 92%. The paper emphasizes the extraction of features such as MFCCs and spectrograms from cry samples and discusses the deployment of the fine-tuned VGG16 model in a real-time hardware system, complemented by a mobile application for user notifications.

**IEEE Reference:**

Anjali, G, Sanjeev, S, Mounika, A, Suhas, G, Reddy, GP & Kshiraja, Y (2022) ‘Infant Cry Classification using Transfer Learning’, TENCON 2022 - 2022 IEEE Region 10 Conference (TENCON), Region 10 Conference (TENCON), TENCON 2022 - 2022 IEEE, pp. 1–7. doi:10.1109/TENCON55691.2022.9977793.

**11**. **A Review of Infant Cry Recognition and Classification based on Computer-Aided Diagnoses**

**Technical Summary:**

**IEEE Reference:** T. Özseven, "A Review of Infant Cry Recognition and Classification based on Computer-Aided Diagnoses," *2022 International Congress on Human-Computer Interaction, Optimization and Robotic Applications (HORA)*, Ankara, Turkey, 2022, pp. 1-11, doi: 10.1109/HORA55278.2022.9800038.

**12**. **An Automated Mood Analysis of Crying Infants Through Sound Recognition Using Hybrid Deep Learning**

**Technical Summary:**

**IEEE Reference:**

S. G. A, G. S, G. Tharagarani, S. P and S. B, "An Automated Mood Analysis of Crying Infants Through Sound Recognition Using Hybrid Deep Learning," *2024 Third International Conference on Smart Technologies and Systems for Next Generation Computing (ICSTSN)*, Villupuram, India, 2024, pp. 1-6, doi: 10.1109/ICSTSN61422.2024.10671224.

**13**. **Refining Baby Cry Classification using Data Augmentation (Time-Stretching and Pitch-Shifting), MFCC Feature Extraction, and LSTM Modeling**

**Technical Summary:**

**IEEE Reference:**

Bella, V. and Sanjaya, S.A. (2023) ‘Refining Baby Cry Classification using Data Augmentation (Time-Stretching and Pitch-Shifting), MFCC Feature Extraction, and LSTM Modeling’, Proceedings of the 7th 2023 International Conference on New Media Studies, CONMEDIA 2023, pp. 250–256. doi:10.1109/CONMEDIA60526.2023.10428158.

**14**. **Speech Signal Processing Based on Machine learning and Complex Processors for Baby Cry Detection System.**

**Technical Summary:**

**IEEE Reference:**

Kolandaisamy, R. et al. (2022) ‘Speech Signal Processing Based on Machine learning and Complex Processors for Baby Cry Detection System’, Journal of Positive School Psychology, 6(2), pp. 2193–2207. Available at: https://research.ebsco.com/linkprocessor/plink?id=50983ecf-a104-34c6-b101-27a94201fb2d (Accessed: 16 November 2024).

**15**. **Is Your Baby Fine at Home? Baby Cry Sound Detection in Domestic Environments**

**Technical Summary:**

**IEEE Reference:**

Khandelwal, T., Das, R.K. and Chng, E.S. (2022) ‘Is Your Baby Fine at Home? Baby Cry Sound Detection in Domestic Environments’, *2022 Asia-Pacific Signal and Information Processing Association Annual Summit and Conference (APSIPA ASC), Signal and Information Processing Association Annual Summit and Conference (APSIPA ASC), 2022 Asia-Pacific*, pp. 275–280. doi:10.23919/APSIPAASC55919.2022.9980350.

**16**. **Baby Cry Recognition by BCRNet Using Transfer Learning and Deep Feature Fusion**

**Technical Summary:**

**IEEE Reference:**

Ke Zhang, Hua-Nong Ting and Yao-Mun Choo (2023) ‘Baby Cry Recognition by BCRNet Using Transfer Learning and Deep Feature Fusion’, *IEEE Access*, 11, pp. 126251–126262. doi:10.1109/ACCESS.2023.3330789.

**18**. **A Comparative Analysis: Enhancing Baby Cry Detection with Hybrid Deep Learning Techniques**

**Technical Summary:**

**IEEE Reference:**

Reddy, K.S. et al. (2023) ‘A Comparative Analysis: Enhancing Baby Cry Detection with Hybrid Deep Learning Techniques’, 2023 International Conference on Next Generation Electronics, NEleX 2023 [Preprint]. doi:10.1109/NEleX59773.2023.10421119.

**19**. **Classification of Infant Behavioural Traits using Acoustic Cry: An Empirical Study**

**Technical Summary:**

**IEEE Reference:**

Jindal, S., Nathwani, K. and Abrol, V. (2021) ‘Classification of Infant Behavioural Traits using Acoustic Cry: An Empirical Study’, 2021 12th International Symposium on Image and Signal Processing and Analysis (ISPA), Image and Signal Processing and Analysis (ISPA), 2021 12th International Symposium on, pp. 97–102. doi:10.1109/ISPA52656.2021.9552159.

**20**. **IoT based Smart Baby Monitoring**

**Technical Summary:**

**IEEE Reference:**

C, V. *et al.* (2021) ‘IoT based Smart Baby Monitoring’, *2021 Second International Conference on Electronics and Sustainable Communication Systems (ICESC), Electronics and Sustainable Communication Systems (ICESC), 2021 Second International Conference on*, pp. 1–6. doi:10.1109/ICESC51422.2021.9532997.

**21**. **Deep Convolutional Neural Network based Feature Extraction with optimized Machine Learning Classifier in Infant Cry Classification**

**Technical Summary:**

K, A. et al. (2020) ‘Deep Convolutional Neural Network based Feature Extraction with optimized Machine Learning Classifier in Infant Cry Classification’, 2020 International Conference on Decision Aid Sciences and Application (DASA), Decision Aid Sciences and Application (DASA), 2020 International Conference on, pp. 27–32. doi:10.1109/DASA51403.2020.9317240.

Ashwini, K., PM, D.R.V., Srinivasan, K. and Chang, C.Y., 2020, November. Deep convolutional neural network based feature extraction with optimized machine learning classifier in infant cry classification. In *2020 International Conference on Decision Aid Sciences and Application (DASA)* (pp. 27-32). IEEE.

**IEEE Reference:**

**22**. **Infant Cry Classification Using Semi-supervised K-Nearest Neighbor Approach**

**Technical Summary:**

**IEEE Reference:**

Mahmoud, A.M. *et al.* (2020) ‘Infant Cry Classification Using Semi-supervised K-Nearest Neighbor Approach’, *2020 13th International Conference on Developments in eSystems Engineering (DeSE), Developments in eSystems Engineering (DeSE), 2020 13th International Conference on*, pp. 305–310. doi:10.1109/DeSE51703.2020.9450239.

**23**. **Speech recognition based IICC - Intelligent Infant Cry Classifier**

**Technical Summary:**

**IEEE Reference:**

Sharma, A. and Malhotra, D. (2020) ‘Speech recognition based IICC - Intelligent Infant Cry Classifier’, *2020 Third International Conference on Smart Systems and Inventive Technology (ICSSIT), Smart Systems and Inventive Technology (ICSSIT), 2020 Third International Conference on*, pp. 992–998. doi:10.1109/ICSSIT48917.2020.9214193.

**24. A Machine-Learning Approach for Children’s Pain Assessments Using Prosodic and Spectral Acoustic Features**

**Technical Summary:**

**IEEE Reference:**

Jamal, A. and Al-Azani, S. (2023) ‘A Machine-Learning Approach for Children’s Pain Assessments Using Prosodic and Spectral Acoustic Features’, *2023 3rd International Conference on Electrical, Computer, Communications and Mechatronics Engineering (ICECCME), Electrical, Computer, Communications and Mechatronics Engineering (ICECCME), 2023 3rd International Conference on*, pp. 1–6. doi:10.1109/ICECCME57830.2023.10252478.

**25**. **Analysis of Multiple Types of Baby Cries Based on LSTM**

**Technical Summary:**

**IEEE Reference:**

You, W. *et al.* (2023) ‘Analysis of Multiple Types of Baby Cries Based on LSTM’, *2023 8th International Conference on Intelligent Computing and Signal Processing (ICSP), Intelligent Computing and Signal Processing (ICSP), 2023 8th International Conference on*, pp. 1141–1146. doi:10.1109/ICSP58490.2023.10248903.