
SmartCry: Identifying Abnormal Infant Cry Patterns Using MFCC And Machine Learning Models

Dattatray Waghole¹, Smita Wagh², Pranav Badole³, Shrutam Hinge⁴, Tanesh Devhare⁵,
Virendra Godse⁶

^{1,2,3,4,5, 6}Department of Computer Engineering, JSPM's Jayawantrao Sawant College of Engineering Pune, India
dattatraywaghole@jspmjscoe.edu.in¹, smitawagh@jspmjscoe.edu.in²,
ppbadole28@gmail.com³, shrutamhinge9@gmail.com⁴, taneshdevhare07@gmail.com⁵,
virendragodse04@gmail.com⁶

Abstract.

Analysis of infant cry patterns is an important approach for understanding various health conditions and needs of newborn babies. This research presents the system SmartCry for categorizing infant cry patterns into normal (hunger) and abnormal (disorders) categories, with main focus on a genetic disorder Cri Du Chat Syndrome. Mel Frequency Cepstral Coefficients (MFCC) is used for extracting various sound features and preprocessing techniques like normalization and segmentation is used to improve sound quality. Models such as Random Forest, CNN-LSTM are used to categorize different crying patterns. An embedded IOT device ESP32 is also used for real time detection. Thus, this system is designed to assist caregivers and parents an early detection of potential health issues.

Keywords. Infant Cry Patterns, MFCC, Machine Learning, Random Forest, CNN-LSTM, SmartCry, Cri Du Chat Syndrome.

1. INTRODUCTION

Infant crying communicates needs such as hunger, pain, and illness [1]–[3]. Abnormal crying patterns can also indicate genetic disorders such as Cri Du Chat Syndrome, characterized by a distinctive high-pitched, cat-like cry [4]. MFCC features and machine-learning models such as Random Forest are widely used for infant cry classification [5]–[7].

2. LITERATURE SURVEY

Research has widely applied acoustic features and machine learning to infant cry analysis [1], [2]. Random Forest has shown effectiveness in distinguishing normal and abnormal cries [3], while studies on Cri Du Chat Syndrome highlight abnormal crying as a potential early health indicator [4].

Table 1. Comparison of the system SmartCry with existing work on Infant Cry Analysis

Algorithm	Cry Detection	Machine Learning used	Disease Detection
Infant Cry Review	Yes	Yes	No
Cry Classification	Yes	Yes	No
Genetic Disorder	No	No	Yes
MFCC analysis	Yes	Yes	No
This Work	Yes	Yes	Yes

3. PROPOSED SYSTEM / METHODOLOGY:

Audio Input Working: Crying audio is collected from the available datasets or from the generated synthetic datasets.

Pre-processing: The input files are processed by extracting all the noise and disturbances, using methods like normalization and segmentation.

Acoustic feature analysis: Various sound features such as pitch and frequency are captured from the collected input and are displayed in number format.

Model Training: Models such as Random Forest is trained to extract numerical values of the acoustic sound features to learn the pattern difference between the crying patterns.

Hardware Integration: After classification of crying patterns, an embedded system such as ESP32 is considered for practical implementation. Henceforth, ESP32 will relate to buzzer, and it will beep only when abnormal crying patterns are detected.

4. ARCHITECTURAL DIAGRAM

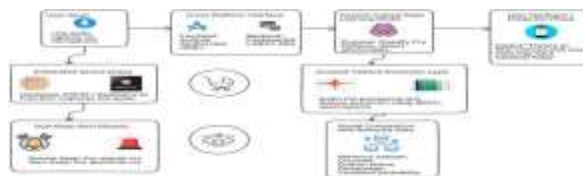


Figure 4.1. System Architecture of the proposed SmartCry system

The proposed architecture in Figure 1 focuses on automated infant cry classification into normal and abnormal crying patterns. The process starts from taking input either from a

microphone or dataset, where infant cry signals are captured which are processed further. Then we move on to the feature extraction stage, where MFCC features represent numerical values of the crying patterns. These features are provided to classification models like Random Forest. For practical implementation, an embedded system ESP32 is considered for real-time audio capture.

5. DATASET DESCRIPTION

Normal infant crying patterns like hunger, discomfort, and burping were obtained from standard datasets which were used in infant cry analysis research [1], [2]. Due to its rarity and limited availability of real-world abnormal cry data for rare genetic disorders such as Cri Du Cha, only a small number of abnormal cry samples are collected from medical and clinical data [3], [4]. To deal with this problem, we worked upon generation of synthetic data for abnormal cry patterns with the help of data augmentation techniques. The final dataset generated consists of both normal and abnormal crying patterns which will be further used for training and testing the classification models.

6. RESULT ANALYSIS

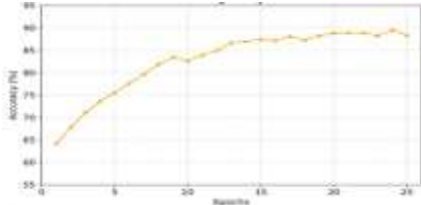


Figure 2: Accuracy vs Epochs Graph

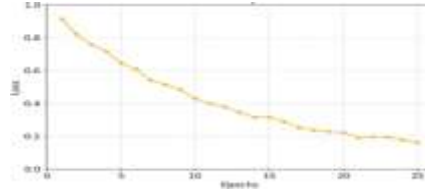


Figure 3: Loss vs Epochs Graph

The Fig 2 shows the accuracy of the model over different epochs. Here we can see that the accuracy keeps on increasing from 64% to 89% thus indicating that the model is effectively learning from the training dataset. The fig 3 shows the loss of the model during training. Here the loss is going from 0.9 to 0.16 hence indicating the prediction error is decreasing over the time.

7. CONCLUSIONS

The proposed system SmartCry shows an effective way of classification and categorization of infant cry patterns. The use of machine learning models increases the prediction capability by capturing both the sound as well as extracting the acoustic features by using Mel Frequency Cepstral Coefficients. The final outcome is a full working prototype, where the software ML model is integrated inside the embedded IOT device which is then placed inside a toy. The IOT device which is connected to a buzzer, will give an alert sound (beep

sound) only when the input audio data/file denotes an abnormal cry pattern (Cri Du Chat Syndrome). It won't give an alter sound for normal crying patterns (hunger, burping).

8. REFERENCES

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Biographies



Dr. Dattatray Waghole, Dean R&D at JSPMs Jayawantrao College of Engineering, PhD in Computer Engineering, with over a decade of experience in teaching with a focus on innovation through expertise in WSN, IoT and ML.



Prof. Smita Wagh, with over five plus years of experience in teaching at JSPMs Jayawantrao College of Engineering, with expiries in IoT, WSN and system programming, focused on innovation in new technologies.



Pranav Badole, 2026 pass out in Computer Engineering under SPPU University from JSPMs JSCOE, with expertise in ML, handling of IoT devices and application development.



Shrutam Hinge, bachelor's degree in computer engineering from JSPMs Jayawantrao College of Engineering, with expertise in Android and flutter development and spring boot working.



Tanesh Devhare, 2026 pass out in Computer Science from JSCOE, with expertise in integration of AI and ML models in wired/ wireless systems as well as skills in CAD integration with AI.



Virendra Godse, passed in Computer Engineering under SPPU University from JSPM College, with expertise in backend handling, java, firebase and deployments.