Adapting Deep Learning Models for Audio Classification to Real-Time Noise Cancellation

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1 RESEARCH QUESTION

Can deep learning models designed for audio classification, like convolutional neural networks (CNNs) which is used to classify an audio signal as a potential emergency situation from Article (Jivitesh Sharma, Ole-Christoffer Granmo, and Morten Goodwin), be adapted to methods used for real-time noise cancellation introduced in article (Porr B, Daryanavard S, Bohollo LM, Cowan H, and Dahiya R)? If successful, could this approach be potentially applied in industrial sensing or consumer applications like noise-cancelling headphones?

2 SIGNIFICANCE

This research question looks into the exciting intersection of audio classification and noise cancellation. With the potential to revolutionize how we handle unwanted sounds. We propose to repurpose deep learning models designed for audio classification to a research that explores the possibility of creating a more sophisticated noise cancellation method. The real-time aspect of this approach further adds to its appeal, making it potentially applicable in various scenarios. Ultimately, the answer to this question could lead to smarter noise-cancelling headphones that filter specific unwanted sounds, improved industrial sensing that allows workers to hear critical signals amidst machinery noise, and even enhanced emergency response systems triggered by automatic audio analysis. In essence, this research explores a novel application that has the potential to significantly improve noise cancellation technology and impact safety and well-being across various domains.

3 NOVELTY

There is existing research on audio classification with CNNs (an article by Jivitesh Sharma, Ole-Christoffer Granmo, and Morten Goodwin) and real-time noise cancellation (an article by Porr B, Daryanavard S, Bohollo LM, Cowan H, and Dahiya R), but they are explored separately. Our question proposes a novel approach that combines these techniques. By leveraging CNNs to identify specific sounds, like emergencies, our system could differentiate them from general noise. The system would then remove only the unwanted noise using real-time noise cancellation methods, effectively preserving the emergency sounds. The novelty lies in integrating these areas for intelligent noise cancellation. Unknown factors include the effectiveness of this approach, its performance in real-world applications, and potential limitations for resource-constrained devices. Exploring these unknowns holds promise for a groundbreaking noise cancellation method based on sound classification.

4 APPROACH

The first step to evaluating this approach is to understand the core functionalities of each method. We'll need to see how the audio classification CNNs (an article by Jivitesh Sharma, Ole-Christoffer Granmo, and Morten Goodwin) identify emergency-related audio patterns. Likewise, we will analyze (an article by Porr B, Daryanavard S, Bohollo LM, Cowan H, and Dahiya R) noise cancellation method to grasp how it differentiates between noise and the desired audio signal. Where we could observe the potential connections between the two approaches.

We can also assess the feasibility of adapting the emergency classification CNN for noise cancellation. This involves considering key differences in their tasks. Can the model's ability to identify emergency patterns be repurposed to distinguish noise? Additionally, noise cancellation requires modifying the audio stream, while classification provides a category label. Can the model's output be adjusted for this purpose?. We will also need to evaluate the model's computational complexity and explore potential optimization techniques. Finally, we'll consider the application potential in industrial settings and consumer headphones. By analyzing these aspects, along with relevant research on the intersection of deep learning for audio classification and noise cancellation, we can achieve the potential of this research.

5 EVALUATION

We can evaluate this solution theoretically by analyzing its potential benefits based on existing research. By combining Sharma et al.'s CNN-based classification for emergency sounds with the real-time noise cancellation method, the system could achieve targeted noise removal. The CNN would identify and preserve emergency sounds, while the noise cancellation would focus on removing unwanted noise. This approach has the potential to improve accuracy compared to traditional noise cancellation, which removes all noise, and separate emergency sound detection systems.

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6 TIMELINE

6.1 Understanding Core Functionalities (April 5th 2024):

- Review and analyze the audio classification CNNs described by Jivitesh Sharma, Ole-Christoffer Granmo, and Morten Goodwin to identify emergency-related audio patterns.
- Analyze the noise cancellation method described by Porr B, Daryanavard S, Bohollo LM, Cowan H, and Dahiya R to differentiate between noise and desired audio signal.

6.2 Identifying Potential Connections (April 10th 2024):

- Explore potential connections between the audio classification CNNs and the noise cancellation method.
- Identify similarities and differences in their methodologies and tasks.

6.3 Assessing Feasibility of Adaptation (April 13th 2024):

- Evaluate the feasibility of adapting the emergency classification CNN for noise cancellation.
- Consider repurposing the model's ability to identify emergency patterns for distinguishing noise.
- Assess the adaptability of the model's output for noise cancellation purposes.
- Evaluate computational complexity and explore optimization techniques.

6.4 Exploring Application Potential (April 17th 2024):

- Consider potential applications in industrial settings and consumer headphones.
- Analyze how the integrated approach could benefit various industries and users.

6.5 Evaluation of Solution (April 24th 2024):

- Theoretically analyze potential benefits based on existing research.
- Assess how combining Sharma et al.'s CNN-based classification with real-time noise cancellation could achieve targeted noise removal.
- Evaluate the potential improvement in accuracy compared to traditional noise cancellation methods.
- Consider how the integrated system preserves emergency sounds while removing unwanted noise.

6.6 Further Research and Optimization (April 27th 2024):

- Identify areas for further research and optimization.
- Explore additional techniques for enhancing the performance and efficiency of the integrated system.

6.7 Documentation and Reporting (May 1st to 5th 2024):

- Document findings and conclusions from the evaluation process.
- Prepare a report outlining the feasibility, benefits, and potential applications of the integrated approach.
- Share findings with relevant stakeholders and researchers in the field.

7 TASK DIVISION

7.1 Santhra Thomas: Project Leader

Guides the entire project, oversees communication, manages deadlines, and contributes to research tasks like data analysis and report writing.

7.2 Joseph Thomas: Literature Review/Coordinator

Conducts a thorough literature review, identifies relevant research methods, and integrates findings into the project while ensuring smooth team collaboration and data visualization.

8 PAPER LIST

Emergency Detection with Environment Sound Using Deep Convolutional Neural Networks: An article By Jivitesh Sharma, Ole-Christoffer Granmo, and Morten Goodwin

Real-time noise cancellation with deep learning: An article By Porr B, Daryanavard S, Bohollo LM, Cowan H, and Dahiya R