IJCRT.ORG   **ISSN : 2320-2882**

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

AUDIO AND ITS APPLICATIONS IN DIFFERENT AREAS

Anam Bansal

Assistant Professor

Central University Of Punjab, Bathinda

Abstract: Audios are the sound signals that are produced by some source and travel to the human or animal's ear. The audios can be used in number of the research areas. Though the text, videos, images can help in numerous applications that audios can solve but the audios have certain advantages as compared to the former. In this paper, research areas related to audios are described. The usage of audios in aircraft industry, healthcare, audio surveillance are explored.

Index Terms - **Acoustics, Acoustic Research areas, Environmental Sound classification.**

I. INTRODUCTION

Acoustics is the branch of physics which deal with the sounds. Sounds are the signals that are produced by air pressure changes. Various kinds of the sounds can be used for designing concert halls, context classification, gunshot detection and many more.

Audios are preferred as compared to text, videos and other tools. Audios have certain advantages as compared to the other sensors. Audios can be captured from any direction. Microphones used for capturing audios are omnidirectional as compared to video cameras which can only focus on one area. Audios are free from occlusion unlike videos. They are not obstructed by any solid objects. Microphones are easy to install and are computationally less costly as compared to cameras. Microphones are insensitive to orientation changes.

Nowadays, number of researchers are working in the field of acoustics. Acoustics have been used in several fields and have helped in research. Fig. 1 illustrates the research areas in which acoustics have been employed. The remaining paper is structured as follows. Section 2 describes the research areas related to acoustics and the corresponding literature review of the applications. Section 3 concludes the paper.
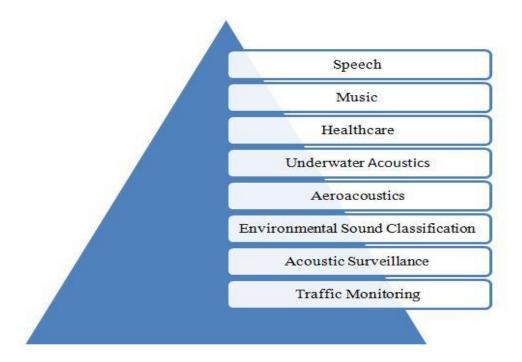

Fig. 1. Research areas related to acoustics

II. RESEARCH AREAS RELATED TO ACOUSTICS

- **Speech**

Acoustics have been widely used in speech processing, speaker identification and speech recognition. The research in speech processing relates to the processing methods used for speech signals. Speech processing helps in creating digital assistants by using deep learning techniques [1] and in healthcare [2] [3]. Speaker identification is the recognising and identifying the speakers from the speech. Speech recognition is achieved using deep neural networks recently [4]. End to end deep neural network and Hidden Markov Based Neural Network is used. Sequence to sequence models are also employed for speech recognition [5].

- **Music Processing**

The branch of acoustics dealing with music is called musical acoustics [6]. Music processing includes research related to the classification of musical instruments [7] [8] [9], classification of music genres [10][11]. In study [12], generative adversarial neural networks are used for singing voice synthesis.

- **Healthcare**

In healthcare, acoustics have been used in number of tasks such as notifying the hospital staff of various events of patients [13], detecting various diseases [14]. Earlier, stethoscopes were used to hear internal sounds of human body but now acoustic sensors installed in hospitals can do the task and detect various ailments such as lung diseases[15], parkinson[16][17], Alzheimer[18]. Though, video cameras can also work in this regard but they are discouraged as they intrude upon the privacy of patients.

- **Aeroacoustics**

Acoustics has been widely employed in aircraft industry [19]such as detection of landing and taking off the airplanes. Acoustics help in detecting invisible damage to the airplanes [20], identifying low flying planes[21], amateur drone detection [22]. Terrorist activities can also be identified through the sounds produced inside the planes [23]. Aeroacoustics also helps to study musical wind instruments[24].

- **Underwater acoustics**

Acoustics help underwater [25] by prevention of accidents as it can detect some objects which can harm the ship[26]. Acoustics also help to monitor the marine life[27] and marine life conversation[28]. SONAR is an example of acoustics based tool that help in detecting some underwater vessels [29].

- **Acoustic Surveillance**

Acoustics have been widely used in the surveillance [30] [31]. The sounds of dog barking, screaming, gunshot can be detected and cetain services or horns can be activated. Smart homes can be designed using acoustics for elderly people staying alone at home [32]. Acoustical surveillance can help in predicting the disease outbreaks early [33]

- **Environmental Sound classification**

The urban sounds can be classified to recognize the environment surrounding the sounds [34] [35]. Certain environmental events can also be classified through sounds [36].

- **Traffic monitoring**

Acoustics are used for monitoring traffic. The traffic conditions using acoustics can be identified as congested and free flowing [37]. Vehicles can also be classified through the sounds produced by them into various categories [38]. Accidents can be detected [39] and emergency services can be called through sounds[40].

III. CONCLUSION

The field of acoustics is currently trending due to the advantages of audios as compared to videos. Tremendous contribution to the various areas has been made by the acoustics from the last two decades. Acoustics will continue to play an increasingly important role in the various fields. This paper is based on the concept of acoustics and research areas of acoustics. We conclude that further research in this area can be done as there are very promising and profitable results obtained in all the research areas discussed. This field and its applications will likely have far-reaching effects on human life in the years to come.

REFERENCES

[1] Reinhold Haeb-Umbach et al. "Speech processing for digital home assistants: Combining signal processing with deep-learning techniques". In: IEEE Signal processing magazine 36.6 (2019), pp. 111–124.

[2] Stephanie Rosemann and Christiane M Thiel. "Audio-visual speech processing in age-related hearing loss: Stronger integration and increased frontal lobe recruitment". In: Neuroimage 175 (2018), pp. 425–437.

[3] Tim Saltuklaroglu et al. "EEG mu rhythms: Rich sources of sensorimotor information in speech processing." In: Brain and language (2018).

[4] Dong Wang, Xiaodong Wang, and Shaohe Lv. "An overview of end-to-end automatic speech recognition". In: Symmetry 11.8 (2019), p. 1018.

[5] Chung-Cheng Chiu et al. "State-of-the-art speech recognition with sequenceto-sequence models". In: 2018 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP). IEEE. 2018, pp. 4774–4778.

[6] Diana Omigie et al. "Experiencing musical beauty: Emotional subtypes and their physiological and musico-acoustic correlates." In: Psychology of Aesthetics, Creativity, and the Arts 15.2 (2021), p. 197.

[7] Surendra Shetty and Sarika Hegde. "Automatic classification of carnatic music instruments using MFCC and LPC". In: Data Management, Analytics and Innovation. Springer, 2020, pp. 463–474.

[8] Apichai Huaysrijan and Sunee Pongpinigpinyo. "Deep Convolution Neural Network for Thai Classical Music Instruments Sound Recognition". In: 2021 25th International Computer Science and Engineering Conference (ICSEC). IEEE. 2021, pp. 283–288.

[9] Sheikh Ali Ahmed and Stergios Adamopoulos. "Acoustic properties of modified wood under different humid conditions and their relevance for musical instruments". In: Applied Acoustics 140 (2018), pp. 92–99.

[10] Ahmet Elbir and Nizamettin Aydin. "Music genre classification and music recommendation by using deep learning". In: Electronics Letters 56.12 (2020), pp. 627–629.

[11] Nikki Pelchat and Craig M Gelowitz. "Neural network music genre classification". In: Canadian Journal of Electrical and Computer Engineering 43.3 (2020), pp. 170–173.

[12] Yukiya Hono et al. "Singing voice synthesis based on generative adversarial networks". In: ICASSP 2019-2019 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP). IEEE. 2019, pp. 6955–6959.

[13] Ceki Paltura and K̈ur¸sat Yelken. "An Examination of Vocal Tract Acoustics following Wendler's Glottoplasty". In: Folia Phoniatrica et Logopaedica 71.1 (2019), pp. 24–28.

[14] Renard Xaviero Adhi Pramono, Syed Anas Imtiaz, and Esther RodriguezVillegas. "Automatic cough detection in acoustic signal using spectral features". In: 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC). IEEE. 2019, pp. 7153–7156.

[15] Adam Rao et al. "Acoustic methods for pulmonary diagnosis". In: IEEE reviews in biomedical engineering 12 (2018), pp. 221–239.

[16] Laureano Moro-Velazquez et al. "Advances in Parkinson's Disease detection and assessment using voice and speech: A review of the articulatory and phonatory aspects". In: Biomedical Signal Processing and Control 66 (2021), p. 102418.

[17] Diogo Braga et al. "Automatic detection of Parkinson's disease based on acoustic analysis of speech". In: Engineering Applications of Artificial Intelligence 77 (2019), pp. 148–158.

[18] Aparna Balagopalan et al. "To BERT or not to BERT: comparing speech and language-based approaches for Alzheimer's disease detection". In: arXiv preprint arXiv:2008.01551 (2020).

[19] Justin W Jaworski and Nigel Peake. "Aeroacoustics of silent owl flight". In: Annual Review of Fluid Mechanics 52 (2020), pp. 395–420.

[20] Bo Luo, Wuli Chu, and Haoguang Zhang. "Tip leakage flow and aeroacoustics analysis of a low-speed axial fan". In: Aerospace Science and Technology 98 (2020), p. 105700.

[21] Alexander Sedunov et al. "Long-term testing of acoustic system for tracking low-flying aircraft". In: 2018 IEEE International Symposium on Technologies for Homeland Security (HST). IEEE. 2018, pp. 1–6.

[22] ˙Ilhan Aydın and Emrullah Kızılay. "Development of a new Light-Weight Convolutional Neural Network for acoustic-based amateur drone detection". In: Applied Acoustics 193 (2022), p. 108773.

[23] Shulin Li et al. "Convolutional neural networks for analyzing unmanned aerial vehicles sound". In: 2018 18th International Conference on Control, Automation and Systems (ICCAS). IEEE. 2018, pp. 862–866.

[24] Juliette Chabassier and Roman Auvray. "Direct computation of modal parameters for musical wind instruments". In: Journal of Sound and Vibration 528 (2022), p. 116775.

[25] Christian Audoly. "Acoustic metamaterials and underwater acoustics applications". In: Fundamentals and Applications of Acoustic Metamaterials: From Seismic to Radio Frequency 1 (2019), pp. 263–285.

[26] Gia-Thuy Pham et al. "High resolution source localization in underwater acoustics for deep sea mining monitoring". In: OCEANS 2019-Marseille. IEEE. 2019, pp. 1–7.

[27] Alison W Watts and JL Miksis-Olds. "The ocean as a living sensor: environmental DNA and acoustics for detecting marine life". In: Proceedings of the National Conference on Marine Environmental DNA 2018. 2018.

[28] Shane Guan, Tiffini Brookens, and Joseph Vignola. "Use of underwater acoustics in marine conservation and policy: Previous advances, current status, and future needs". In: Journal of Marine Science and Engineering 9.2 (2021), p. 173.

[29] Haesang Yang et al. "Underwater acoustic research trends with machine learning: Passive SONAR applications". In: Journal of Ocean Engineering and Technology 34.3 (2020), pp. 227–236.

[30] Allaa R Hilal et al. "A distributed sensor management for large-scale IoT indoor acoustic surveillance". In: Future Generation Computer Systems 86 (2018), pp. 1170–1184.

[31] Eva Lieskovska, Maros Jakubec, and Roman Jarina. "Acoustic surveillance system for children's emotion detection". In: 2019 42nd International Conference on Telecommunications and Signal Processing (TSP). IEEE. 2019, pp. 525–528.

[32] Anastasios Vafeiadis et al. "Audio content analysis for unobtrusive event detection in smart homes". In: Engineering Applications of Artificial Intelligence 89 (2020), p. 103226.

[33] Juan Carlos Gabaldon-Figueira et al. "Digital acoustic surveillance for early detection of respiratory disease outbreaks in Spain: a protocol for an observational study". In: BMJ open 11.7 (2021), e051278.

[34] Sajjad Abdoli, Patrick Cardinal, and Alessandro Lameiras Koerich. "Endto-end environmental sound classification using a 1D convolutional neural network". In: Expert Systems with Applications 136 (2019), pp. 252–263.

[35] Zohaib Mushtaq and Shun-Feng Su. "Environmental sound classification using a regularized deep convolutional neural network with data augmentation". In: Applied Acoustics 167 (2020), p. 107389.

[36] Xifeng Dong et al. "Environment sound event classification with a twostream convolutional neural network". In: IEEE Access 8 (2020), pp. 125714–125721.

[37] Anuntapat Anuntachai and Kittituch Pavaranchanakul. "Analyze traffic conditions and events with sound processing". In: 2020 20th International Conference on Control, Automation and Systems (ICCAS). IEEE. 2020, pp. 344–349.

[38] Anam Bansal et al. "An off the shelf CNN features based approach for vehicle classification using acoustics". In: International Conference on ISMAC in Computational Vision and Bio-Engineering. Springer. 2018, pp. 1163– 1170.

[39] Matteo Sammarco and Marcin Detyniecki. "Car accident detection and reconstruction through sound analysis with Crashzam". In: Smart Cities, Green Technologies and Intelligent Transport Systems. Springer, 2018, pp. 159– 180.

[40] Abdul Mateen et al. "Smart roads for autonomous accident detection and warnings". In: Sensors 22.6 (2022), p. 2077.